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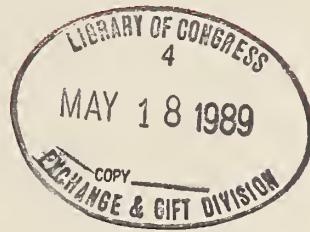




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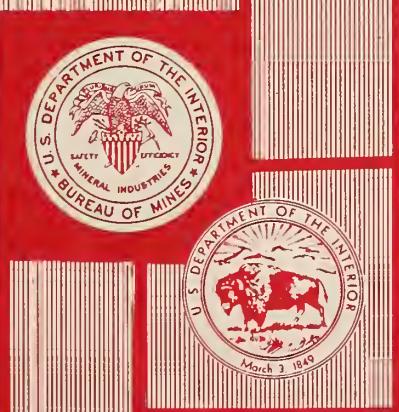
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## Reducing Miner Absenteeism

By Robert H. Peters, Mark R. Clingan,  
and Robert F. Randolph



UNITED STATES DEPARTMENT OF THE INTERIOR



**Information Circular 9219**

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**UNITED STATES DEPARTMENT OF THE INTERIOR  
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## UNIT OF MEASURE ABBREVIATIONS USED IN THIS REPORT

d/yr	day per year	pct	percent
mg	milligram	yr	year
mg/d	milligram per day		

# REDUCING MINER ABSENTEEISM

By Robert H. Peters,<sup>1</sup> Mark R. Clingan,<sup>2</sup> and Robert F. Randolph<sup>3</sup>

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## ABSTRACT

The U.S. Bureau of Mines has prepared this report on strategies for maintaining high job attendance among underground coal miners because high absenteeism is a threat to miners safety and seriously hampers productivity. A substantial number of research studies on the effectiveness of various strategies for reducing absenteeism among the employees of nonmining industries have been reported in the literature. These strategies have aimed at improving job attendance through one or more of the following: (1) improving employment procedures, (2) overcoming problems that adversely affect one's ability to attend work, and (3) increasing miners motivation to attend work. Many of these strategies appear applicable to the mining industry, and are reviewed in the first half of this report. The second half of this report describes how one could develop and implement a program for maintaining high attendance at underground coal mines. The steps include: measuring and evaluating attendance levels; formulating attendance goals and an absenteeism policy; developing and implementing an attendance promotion program; and periodically going through the preceding steps known as recycling.

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## INTRODUCTION

The Bureau of Mines has prepared this report describing strategies for minimizing absenteeism among coal miners because (1) absenteeism appears to be an important deterrent to mine safety and efficiency (*1, 10, 39, 57*),<sup>4</sup> and (2) there appear to be several effective strategies for achieving high attendance, which mine operators may not have considered.

Although estimates for the rate of absenteeism in the mining industry vary, most sources suggest that it is high relative to other industries. Based on attendance data collected in May 1978 and 1980, the U.S. Bureau of Labor Statistics reported that among all major U.S. (nonfarming) industries, mining was the highest in terms of the proportion of hours lost to absences (49, 52). Given current high rates of unemployment in the mining industry, absence rates in the late 1980's are probably not as high as they were in the preceding decade. The U.S. Bureau of Labor Statistics May 1985 survey found that absenteeism in the mining industry was 3.6 pct, which is lower than the corresponding percentage for 1980 by 1.8 percentage points (51). Although the problem is not as widespread today as it once was, it still exists, and will continue to come back to haunt the mining industry from time to time until mine managers learn better methods for controlling it.

It is inevitable that members of underground coal mining crews will occasionally be absent. Sometimes the crew will work without a replacement, but usually someone is assigned to fill in for the missing miner. In either case, production and safety problems become more likely.

Underground coal miners work in a relatively hazardous environment, and the jobs they perform are relatively interdependent. The entire production process can be stopped if any of several critical activities are not performed properly. Temporary replacements for regular crew members are relatively unfamiliar with the habits of the people who work in the crew and the physical conditions and equipment in the section.

Consequently, temporary replacements often either do things (or fail to do things) that can reduce productivity and contribute to accidents.

There appears to be much speculation about how one should attack the problem of miners absenteeism. Two examples are as follows:

What we need is motivation, and money doesn't have the motivational power it used to have. If a man can take care of his needs on \$7 an hour in four days, raising his pay to \$10 won't motivate him to work five days. And the threat of firing doesn't do much good. You discipline in hopes of improving attendance, hoping the message will get across to the other employees, but usually it doesn't work. In 1976 you have to treat people differently than you did in 1936. You can't always be cracking the whip. It just doesn't work (57).

Absenteeism should be seen and treated as a symptom, not the disease. Like medical symptoms, absenteeism may be telling management something is wrong. To suppress the symptom may mask a problem that needs management attention. Therefore, the approach to an absentee program should be to reward good work habits rather than to punish poor work habits (1).

There is almost no empirical evidence concerning the effectiveness of interventions that might reduce miners absenteeism. However, a substantial amount of research has been conducted to determine the effectiveness of various strategies which have been used to reduce absenteeism in nonmining industries. The first half of this report discusses the research evidence concerning these strategies. Then, based on this evidence and what is known about absenteeism in the underground coal mining industry, the second half of this report proposes some guidelines concerning the development and implementation of programs to improve miners attendance.

## STRATEGIES FOR REDUCING ABSENTEEISM

According to Goodman (*10*), the major determinants of absenteeism vary significantly from one group of miners to another. Furthermore, the best strategies for reducing absenteeism vary with the causes of the absenteeism, making it important to choose strategies that fit the major causes. Peters (*39*) reviewed the various causes of employee absenteeism, and proposed a model of the major determinants of miners absenteeism. Their model, like several others that have been proposed in the literature on employee absenteeism, assumes that at the most basic level, all absenteeism stems from either a lack of ability or a lack of motivation or some combination of the two.

The strategies available for reducing miners absenteeism can be divided into three major categories. One category of strategies is concerned with overcoming problems that sometimes make miners **unable** to attend work. A second major category of strategies deals with techniques for increasing miners **motivation** to attend work. The remaining category of strategies concerns the reduction of absenteeism through **improving employment procedures**. This strategy seems to be appropriate in the widest variety of situations, and is discussed first.

### IMPROVING EMPLOYMENT PROCEDURES

Several experts have suggested that the mining industry should consider improving the process of hiring new employees (*10, 50, 57*). Two ways to improve the hiring process are to (1) examine prospective new employees' prior attendance records, and (2) provide them with realistic job previews.

Research by Breugh (*5*) and Keller (*21*) suggests that prospective employees' prior attendance records should be given some consideration in selection decisions. Both studies found that employees' prior absenteeism was a statistically significant predictor of their future absenteeism. Thus, it appears that prior attendance records could be a very simple, but effective device for evaluating the propensity for prospective employees to be absent.

Each company should be able to demonstrate that the employee selection devices it uses are valid, i.e., the criteria used to select applicants for employment do in fact reliably discriminate between applicants who will perform at an acceptable level versus those who will not. Without suitable evidence (as defined by Equal Employment Opportunity Commission (EEOC) laws) the company may have difficulty defending against claims of unfair hiring practices.

Realistic job previews can be a complementary mechanism to good selection practices. Not a single technique, the realistic

<sup>4</sup> Italic numbers in parentheses refer to items in the list of references preceding the appendix at the end of this report.

job preview is rather a philosophy or approach. The goals of the preview are (1) to ensure a good match between the capabilities and needs of the applicant, and the requirements of the job and company (including attendance policies); and (2) to be sure that the applicant has a good picture of both the positive and negative aspects of the job (54). It is assumed that giving candidates and newcomers accurate and complete information will result in better matching of jobs to candidates, and better matching will result in increased satisfaction and commitment, and lower turnover and absenteeism. The realistic information could be transmitted to miners through booklets, films, mine tours, video tapes, realistic work samples, interviewers, supervisors, other recent hires, or a combination of these approaches.

Given the profound differences between underground coal mines and most other work settings, it is especially important that prospective new miners have a good understanding of the positive and negative aspects of working in a mine. The underground environment and its associated hazards and discomforts are likely to be completely foreign to those who have never worked underground. The technology of modern mining is also likely to be difficult for nonmining persons to comprehend.

Realistic job previews might help to attract a more reliable and capable pool of job applicants from which employers can select new miners. Various experts have noted that, as an occupation, coal mining has a rather poor image.

The National Academy of Sciences (34, p. 69) study of coal miners states, "The image of the coal miner as a dirty, ignorant, substandard human with a strong back, a weak mind, and a poor ill-fed family living in a shack on the side of a mountain dies slowly." The report points out that this is no longer an accurate picture: "Today's coal miner, with stable employment, seeks to maintain a middle-class life style. He views himself more and more as a skilled technician."

Although job previews have been empirically demonstrated to reduce turnover and improve employee job satisfaction (54), there appears to be no research concerning their effects on attendance. Owing to the lack of data concerning the impact realistic job previews actually have on employee attendance rates, there is need for caution in making any predictions about how they will influence miner attendance.

The remainder of this section about strategies for reducing absenteeism is organized according to the various specific causes of absenteeism.

## OVERCOMING INABILITY PROBLEMS

The major reasons employees are unable to attend are physical and mental health problems, occupational hazards, and transportation problems. The remainder of this section presents strategies for reducing each of these types of barriers to miners' job attendance.

### Physical Health Problems

In studies by both Goodman (10) and Peters (39), almost all miners cited illnesses as the most common cause of their absences. Illness is widely recognized as the most important cause of absenteeism (15-17, 29), accounting for from one-half to two-thirds of all employee absences (32).

Hejda's (18) study of Czechoslovakian coal miners suggests that the administration of vitamin C and influenza vaccinations may be an effective technique for reducing the number of days lost to illnesses. During the winter months from 1971 to 1974, coal miners were given doses (100 mg/d) of vitamin C by their employer. During this time period, records

were kept of the number and duration of illnesses suffered by the miners in control groups (those given a placebo) and experimental groups (those receiving vitamin C from their employer). In later stages of the study, the experimental group received influenza vaccinations in addition to daily doses of vitamin C.

A significantly lower proportion of miners fell ill in the experimental groups than in the control groups, and the average duration of miners' illnesses in the experimental groups was markedly shorter. It was also observed that the incidence of illness among the group who received vaccinations and vitamin C was lower than the incidence of illnesses among a group who received vaccinations, but did not receive vitamin C. The incidence of illnesses was highest in the control group that was not vaccinated or administered vitamin C.<sup>5</sup>

A worker who is more susceptible to illness, or one who has certain chronic illnesses, is more likely to be absent. There are a variety of possible strategies to deal with illness as a cause of absenteeism. Better selection procedures could eliminate chronic cases. Making in-house medical services, special testing programs (e.g., hypertension), and health education programs available is another possible response to personal health problems. Unfortunately, other than the study by Hejda (18), there appears to be little or no empirical evidence concerning the effects of any type of health improvement intervention on reducing coal miners absenteeism rates.

## Mental Health Problems

Mental health problems include chronic emotional problems (e.g., depression) and other forms or symptoms of emotional illness (e.g., alcoholism and drug abuse). Selection and employee assistance programs (EAP's) are the most traditional methods for dealing with mental health problems. The first method attempts to improve the procedures for screening out workers with mental health problems that might interfere with their job performance.

EAP's are designed to provide diagnosis, referral, treatment, and followup for workers with mental health problems. The assumption behind EAP's is that relieving these emotional problems will enhance worker attendance, safety behavior, and productivity. A recent study of an EAP, which services four coal mines (approximately 1,500 employees), suggests that much like other segments of the population, a significant number of coal miners are experiencing various types of mental health problems (11). Figure 1 shows the number of clients experiencing various types of diagnosed problems during the years 1980 through 1983.

There are many types of EAP's. While some are broad-brush, others are specific (e.g., alcoholism); some only provide diagnostic and referral services; and others also include treatment (see Campbell (7) and Goodman (11) for further details).

## Occupational Hazards

In the coal mining industry, injuries are a particularly important cause of employee absence. According to Mine Safety and Health Administration (MSHA), during the years 1980 through 1984, an average of 1.42 pct of the total days of work scheduled for employees of underground coal mining operations were missed because of work-related injuries (53). The five annual percentages ranged from 1.29 pct to 1.59 pct.

<sup>5</sup> Although Hejda's study showed that vitamin C significantly reduced the incidence of illnesses, other research findings suggest that supplementing one's diet with daily doses of vitamin C is not particularly effective in preventing certain types of illnesses such as the common cold.

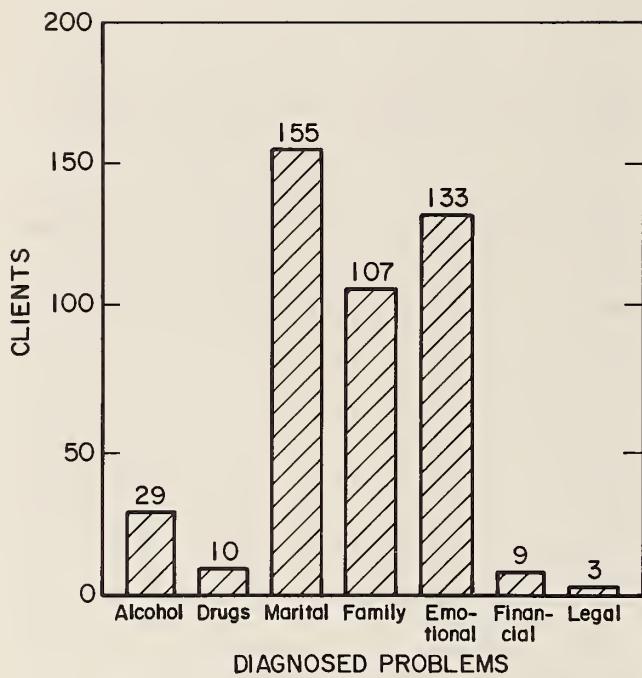


Figure 1.—Number of EAP clients experiencing various types of problems during the years 1980–83. Note that multiple problem definitions could be assigned to single client.

Of the various types of work-related injuries suffered by miners, back injuries account for a greater amount of lost time than any other single type. Back injuries account for approximately 31 pct of the total workdays missed by underground coal miners because of work-related injuries (38).

In two studies (2, 28), it has been found that workers who feel they are being exposed to dangerous or unhealthy working conditions have substantially higher absence rates than other workers. Allen argues not only do hazardous working conditions cause absences directly, i.e., through lost time injuries, such conditions also cause high absenteeism indirectly—employees wish to avoid their workplace because it is perceived as a threat to their safety and health.

Because work-related accidents are an important cause of coal miners absenteeism, one should not overlook the importance of an effective company safety program as a deterrent to absenteeism. For a discussion of the characteristics of effective safety programs for the mining industry, see Peters (40).

### Transportation Problems

Factors such as driving distance to work, bad roads, weather, or other transportation problems, are related to absenteeism. This is common in the mining industry, where the mines are often in isolated rural areas and workers have to drive long distances to get to work. Some companies in mining and nonmining industries have provided transportation (e.g., company buses) to reduce absenteeism. Unfortunately, there are no cost-benefit analyses to indicate the effect of these procedures.

### OVERCOMING MOTIVATIONAL PROBLEMS

There is not much empirical evidence concerning the determinants of miners motivation to be absent from work. In Goodman's (10) study, coal miners were asked various ques-

tions about what motivates them to be absent. Attractive features of the nonwork environment (e.g., going hunting, engaging in social activities) were cited more often than unattractive features of the work environment (e.g., disliking the job, supervisor) as reasons for missing work.

There is hardly any good empirical evidence concerning the effectiveness of various attempts to increase miners attendance. However, there are several good empirical evaluations of the effectiveness of various interventions on increasing nonmining employees' attendance. Research suggests that mine operators should consider the following strategies for increasing miners attendance motivation: conducting training, publicly posting attendance information, redesigning jobs, changing wage and benefit policies, and implementing attendance based incentive programs.

### Training

Training can be an important strategy for reducing absenteeism. Training for this purpose has been conducted for supervisors and for employees.

### Training for Supervisors

There is very little empirical evidence concerning the effects of supervisory training on absenteeism. However, training the supervisor to deal with absenteeism seems an important strategy in reducing absenteeism since the supervisor is the person who deals first (and on a continuing basis) with the absentee problem. Latham (26) states that supervisors are a key to keeping attendance rates high.

It is they who should be responsible for keeping attendance records, so that a high attendance rate can be rewarded and a low attendance rate can be corrected. This is not likely to be done if the attendance data are buried in time cards, if the supervisor is continually second-guessed by others on judgments regarding the "whys" underlying an absence, if the supervisor is not trained in how to focus on problems rather than personalities, and if the rules regarding attendance are vague and subject to many interpretations.

Adkins (1) also stresses the importance of making sure that supervisors understand how to respond to their subordinates' absenteeism.

When a problem individual begins to show up in the records, someone who knows him [most likely the immediate supervisor] should talk with him about it face to face before he gets letters on company stationery. The latter only breeds hostility and resentment. Consistent and even handed administration of the program, particularly the disciplinary aspects, is likely to be more important to worker acceptance than are the details of the program.

A Bureau of National Affairs' (BNA) survey found that, although supervisors in 82 pct of the firms are charged with maintaining daily attendance records, only 42 pct of the companies train supervisors in absence control (6). The BNA report indicates the firms that train their supervisors on absence control provide instruction on: techniques for counseling employees, recognizing attendance problems, handling verbal reprimands, and other disciplinary procedures. Although a few companies educate their supervisors in absence control through one-to-one consultation with a personnel department staff member, most provide the information through supervisory meetings, seminars, or films.

The BNA report tells of one employer's attempt to standardize supervisory training in absence control through the development of a booklet describing the supervisor's role

in sick leave administration. The booklet describes types of health problems, circumstances for which sick leave may be taken, and instructions for processing sick leave requests. A major intent of this publication is to provide a set of uniform guidelines so that all supervisors will be following the same standards in making sick leave decisions. Goodman's (10) study of coal miners absenteeism suggests that this approach could be beneficial to the mining industry. One of Goodman's conclusions is that absence control policies are often unclear and inconsistently applied. In Goodman's (10) study 45 pct of the miners reported that management makes exceptions in the administration of the absence control plan. Goodman notes that these inconsistencies may cause much confusion about what constitutes a legitimate reason for absence, and that such confusion is likely to cause perceptions of unfair treatment and labor-management conflict.

In addition to providing supervisors with instructions about the details of the company's absence control policy, it may also be beneficial for them to practice carrying out these instructions. Wexley (56) found that having supervisors participate in role-playing exercises related to violations of organizational attendance rules resulted in decreased absenteeism.

### Training for Employees

Research by Rosen (41) suggests that orientation training for new employees on the details of the company's attendance rules is a useful way to ensure good attendance rates. These researchers claim that, through orientation training, attendance rates for hard-core hires were as good as the rates for stable employees, i.e., those who had met normal hiring criteria.

Goodman (10) claims it is important to supplement orientation training with periodic training about the absentee control plan. Goodman (10) claims that discussing the plan in an orientation session may have a short-term effect, but will not affect absenteeism over time.

### Posting Attendance Information

Measuring absenteeism and posting attendance information may reduce absenteeism. Latham (26) states,

From the standpoint of motivation, measurement in itself may be the most highly effective, underused, and deceptively straightforward approach available for increasing attendance. The process is effective because "what gets measured gets done." The simple act of putting a measure on something focuses attention on that area.

Latham (26) reports several studies used publicly reported attendance information to significantly decrease absenteeism. Latham (26) admits this intervention requires some increase in clerical-computer costs, but claim that these costs are likely to be trivial in comparison to the gains realized from significantly higher attendance rates.

A study conducted at Parkdale Mills, Inc., located in Lexington, NC, nicely illustrates the effectiveness of this approach (31). Prior to the study, people who were absent were reprimanded. Those who had good attendance records received no comments. A 15-week baseline showed that attendance averaged 86 pct. At the end of the baseline period, a daily attendance chart was placed in the work area. A blue dot was placed on the chart beside the name of each person who was on the job. A red dot was placed beside the name of each person who was off the job. A person who had been absent was welcomed back to the job by the supervisor. No oral or

written reprimands were given. The supervisor maintained this graph daily. In addition, a weekly attendance graph was posted that showed the percentage of people who attended the job each day. From a baseline average of 86 pct, attendance averaged 94.3 pct for the following 9-week period. The costs of this program were less than \$10.

### Job Enrichment

An important determinant of employees' motivation to attend work is the level of job involvement. According to Katz (20), in order to arouse and maximize job involvement, the job must provide sufficient variety, complexity, challenge, and exercise of skill to engage the abilities of the employee. Katz argued further, that job involvement occurs to the extent that employees (1) participate in important decisions about group objectives, (2) contribute to group performance in a significant way, and (3) share in the rewards of group accomplishment.

In Kanungo's (19) review of research on the consequences of job involvement, it was concluded, "On the basis of the existing evidence, it seems reasonable to assume a negative relationship between job involvement and absenteeism, but the evidence is limited to only a few studies." Redesigning jobs in ways that increase the employee's involvement is often referred to as job enrichment. In the review of attempts to enrich jobs in various types of organizations, Goodman (13) notes there has been a trend toward experimenting with new forms of job and organizational design over the past 10 yr, and that these interventions usually result in lower levels of absenteeism.

A well-known attempt at job enrichment in the underground coal mining industry is the experiment conducted at the Rushton mine near Osceola Mills, PA. Although the experiment involved several types of changes (e.g., job rotation<sup>6</sup> and a uniform pay rate), the most significant was the creation of autonomous work groups. Supervisors were removed from face crews, and the crews were given full responsibility for planning and carrying out their own work. One consequence of the Rushton experiment was it significantly decreased absenteeism (See Goodman (9)).

### Wage and Benefit Levels

The effect of pay levels on absenteeism is unclear. Some have argued that changing an employee's pay creates an imbalance between the employee's desire for more income versus the desire for more leisure time (28, 47). They argue that by raising income, the employee's desire for money will decrease relative to the desire for additional leisure time. Indeed, having more income may enable one to get more enjoyment from one's leisure time. This line of argument suggests that pay increases will cause employees to place a higher priority on the acquisition of additional leisure time (perhaps through absenteeism), and will make them more willing to forego the income that might have to be sacrificed for failing to report to work.

Others have argued that higher pay levels discourage absenteeism by raising the opportunity costs of being absent, i.e., the higher one's pay rate, the greater the sacrifice one makes by foregoing a day's pay to be absent (8). There is empirical support for both of these conflicting theoretical arguments (8, 28). Unfortunately, there appears to be no empirical tests of the effects that changes in pay levels have on miners absenteeism.

<sup>6</sup> Instead of performing only one job, the miners within a crew regularly switched jobs such that, over time, each person spent roughly the same amount of time performing each of the jobs involved in operating a section of the mine.

In the fringe benefit area, there is clearer information about the effect of policies such as sick leave and their impact on absenteeism. Dalton (8) report that companies with more generous sick leave benefits—and those that do not remunerate unused sick leave—have higher absenteeism. This finding has some important implications for controlling miners absenteeism. However, because the finding is based on a limited amount of empirical evidence, one needs to be cautious about making inferences until more research has been done on this issue.

### Incentive Programs

Three general types of incentive programs have been used to reduce absenteeism: positive incentive programs, negative sanctions programs, and mixed programs—ones that used positive and negative incentives.

#### Positive Incentive Programs

Positive incentive programs provide some reward for high attendance. Steers (46) review of research on these programs indicates that reinforcers such as bonuses, participation in a lottery, participation in a poker hand, food credit reimbursement for unused sick leave, and desirable work schedules can lead to increased attendance. While there are other programs using positive incentives that did not lead to a reduction in absenteeism, the majority of the empirical evidence supports the effectiveness of positive incentive programs. One criticism of these programs is that they are not always cost effective. Kempen (22) notes that they are often not cost effective because all the perfect or near-perfect attenders receive the money (or reward), even though they cannot improve their attendance. To avoid this cost, Kempen suggests that two questions be asked: (1) What privileges would people like to have that they do not have now? (2) What do they find irritating or aversive in the work setting? The answers to these questions provide a list of possible rewards for increasing attendance that may not be costly to the organization. Examples of nonmonetary privileges for good attendance that have been tried include: freedom from punching time clocks, one or two excused days off with pay, and immunity from disciplinary action for a year related to absence taking.

#### Negative Sanctions

Programs based on negative sanctions are built around absentee control plans. Control plans usually specify stages, levels of absenteeism permitted, penalties, and continuous attendance necessary to remove oneself from a particular disciplinary stage of the absentee control plan. Basically these plans identify a series of stages of varying forms of punishment. For example, absenteeism at a particular level would lead to a warning letter. Subsequent levels of absenteeism would lead to a suspension. Continued absenteeism would lead to dismissal.

Wilkinson (57) quotes an arbitrator who decided for Lykes Resources, Inc., a subsidiary of Youngstown Mines Corp., Youngstown, OH in a UMWA appeal of suspensions as saying, "there is nothing unreasonable about expecting an employee to work regularly. Without a dependable work force, whether in a mine, a mill, or an office, an employer cannot produce the product that produces the money for the payroll." However, it is important that absence control programs meet just-cause standards. In this regard, Rosenthal (42) has noted the following:

1. The rules regarding an attendance policy not only must be published, but they must be communicated directly to the employees.

2. Clarity is essential. An arbitrator found a discharge to be without just cause because the rules required only notice to management regarding an absence without stating that the employee must do the notifying. The employee had a friend notify the supervisor that he wouldn't be coming to work.

3. The organization must make it clear that it intends to enforce the attendance rules.

4. Management discretion must be minimized. In one case, a company excused absences due to "acts of God." An arbitrator ruled that the company was remiss in not ruling an absence that occurred as a result of a snowstorm an "act of God."

5. Consistency must exist in the application of the program rules to all employees.

6. Length of employment is given little weight by arbitrators.

7. Progressive discipline steps should be followed, such as an oral warning, a written warning, and a suspension before termination occurs. Arbitrators do not see excessive absenteeism in and of itself as just cause for discharging a person. An employee may be discharged for just-cause (excessive) absenteeism only if industrial due process (as that term has been interpreted by the individual arbitrator) has been afforded.

Despite the widespread use of management sanctions in business organizations (6), the evidence supporting the effectiveness in attendance control is limited largely to anecdotal case studies—very little empirical research of acceptable quality has been performed. For example, Seatter (45) discussed an attendance control program based on relatively strict disciplinary measures implemented over a 5-yr period. While Seatter reported a major (and sustained) reduction in absence rates during the time period, it was impossible to separate the program's effects from the multitude of uncontrolled variables that could have accounted for the improvement in attendance.

According to Baum (4) and Steers (46), the literature is characterized by divided opinions and conflicting findings concerning the efficacy of sanctions in reducing absenteeism. Much of the opposition to the use of sanctions is based on two grounds: (1) behavior modification techniques based on positive reinforcement of desired behaviors (coming to work regularly) are more suitable and effective in dealing with absenteeism; (2) sanctions based on the use of disciplinary procedures (punishments) tend to produce undesirable side effects that are as objectionable as the behavior of primary interest (3). For example, Nicholson (36) found that rigorously enforced sanctions caused workers to resort to longer, medically related absences to escape the consequences of the disciplinary system; the overall level of days lost was not changed by the clamp-down.

In contrast, a well designed study by Baum (4) found that the strict enforcement of the control policy "had no discernible effect on either long term illnesses or contractual absences," and that the overall level of days lost was significantly reduced by the clamp-down. The sample consisted of 336 workers selected randomly from three departments of a large, midwestern components manufacturing division of one of the big three automobile companies. The jobs in question were union blue-collar production and maintenance jobs at the same hierarchical level within the company, but paying considerable above the median wage for the geographic region. The study employed a nonequivalent control group design since it was not possible to randomly assign subjects to the treatment and control groups. Absenteeism was defined as the number of days the worker failed to report to the job when work was scheduled, excluding long-term illnesses and contractual absenteeism.

In the experimental group, management used the following six-step procedure in all cases of unauthorized absenteeism: (1) detailed attendance records would be kept by the worker's supervisor; (2) written excuses from legitimate outside sources would be required for unauthorized absences; (3) questionable excuses would be independently investigated; (4) management would personally counsel all workers with unauthorized absences; (5) the existing progressive discipline system would be used to penalize excessive absenteeism; and (6) updated discipline and attendance records would be maintained on all workers. The managers in the two comparison departments continued with the existing attendance policy, which simply delegated the responsibility for attendance control to the immediate supervisor.

A prepost measure of absenteeism served as the criteria for evaluating the intervention. The independent variable was whether the attendance control policy would be enforced casually or strictly. Within the experimental and control groups, employees were further categorized (for analysis purposes) according to their past absence rates as being a high-, medium-, or low-absence worker. It was found that, in comparison to high-absence workers in the control group, the intervention reduced absenteeism among high-absence workers in the experimental group by a significantly larger extent (probability ( $p$ ) < 0.05). The chronically absent workers, who were subject to the attendance control policy, improved their attendance an average of 7 d/yr over the comparison group. The intervention produced no change in the absence rates of the two groups of more regular attenders. However, significant improvements in these two groups were not considered to be as important as improvements in the group of chronically poor attenders. Although the group of chronic absentees were only 25 pct of the sample, they accounted for 56.5 pct of the total days lost during the year prior to the intervention.

Goodman's (10) study of absenteeism at 15 coal mines during the early 1980's suggests that the situation is similar in the coal mining industry, i.e., a relatively small percentage of the total workforce accounts for a disproportionately large percentage of the total number of days lost to unexcused absenteeism. Goodman (10) reports the percent of total days of unexcused absenteeism that could be attributed to the 10 pct of the workforce with the highest levels of unexcused absenteeism at each mine for each year. The average of these percentages was 32.1, which suggests that 10 pct of the workforce accounts for about a third of total unexcused absenteeism.

Although Baum's (4) study focused on the use of negative sanctions, it is important to include both negative and positive rewards in programs to improve attendance.

It seems unrealistic for managers to assume that a given control policy will be perceived in the same way by the best and worst attenders in the work force. Workers who are absent infrequently have demonstrated a basic commitment to the managerial ethic that good attendance is a prerequisite to successful performance. The organizational reward system (pay, promotion opportunities, supervisory praise, etc.) has been internalized to the point that these workers perceive that it is in their best interest to attend regularly. The use of sanctions to encourage marginal improvements in attendance would appear to be dysfunctional in the case of regular attenders. If improvements in attendance are desired among these workers, then positive reinforcements to attend more regularly have considerable potential. Chronic absentees, however, have already exhibited a pattern of behavior suggesting that their organization's reward system is not particularly salient to their basic needs. They have been willing to forego higher pay and other rewards associated with

regular attendance for more time away from the job. It seems highly unlikely that a control policy based on positive reinforcements similar to the lottery incentive system of Pedalino (37) will be sufficiently attractive to cause chronic absentees to alter their previous patterns of behavior.

### **Mixed Consequence Plans**

Plans that include both positive incentives for attendance and negative sanctions for absences have been devised and empirically tested (14, 23-25). These mixed consequence plans were generally found to be quite effective at reducing absenteeism. The design of these mixed plans varied considerably. Those who wish to find out the details of each of these plans are referred to the four articles cited above. Several leading researchers and practitioners have spoken highly of this type of plan (1, 4, 26, 46).

### **Participation in Incentive Plan Design**

Two nonmanagement groups are sometimes included in the design of incentive plans to improve attendance: employees and unions. Research suggests that their participation can help to ensure the success of the plan.

#### *Employee Involvement*

Latham (26) suggests that greater employee involvement in designing an absentee system may increase employee's motivation to adopt the system as their own. If the absentee system is seen as the employee's own construction, they will more likely follow the rules. Three suggestions for initiating a program of employee involvement in absenteeism reduction are as follows:

(1) Provide employees with information that will help convince them that absenteeism is a problem which they should be concerned about. Give them information about absenteeism rates, the costs of absenteeism, and the consequences of high absenteeism to the worker in terms of safety or job security.

(2) Provide an opportunity for employees to participate in the design of an absenteeism program, which will create positive incentives for attendance and sanctions for high absenteeism.

(3) Provide an opportunity for employees to monitor absenteeism over time, and monitor the effectiveness of the program to reduce absenteeism.

Scheflen (44) performed a well designed field experiment on the effects of employee participation in the development of pay incentive plans to increase attendance. Three groups of building maintenance employees developed their own incentive plans to reward high attendance, and identical plans were then imposed by company management in two other work groups. A significant increase in attendance was found during the first 16 weeks following implementation of the plans only in the groups where the plans were participatively developed. Attendance rates were not significantly altered in the groups subjected to the management-imposed plans. A followup evaluation conducted 1 yr after the original plans had been installed revealed that attendance was still higher in the groups that had been allowed to participate in designing their own plan.

#### *Union Involvement*

Programs developed by union and management may be another way to deal with absenteeism. As previously mentioned, absenteeism can cause grievances. Therefore, both union and management have a stake in dealing with this issue.

Some unions and companies (e.g., United Auto Workers and General Motors) have established joint committees at the national and local levels to seek ways to deal with absenteeism. There are no data available to assess the effectiveness of joint labor-management efforts on absenteeism.

## CURRENT PRACTICES

The BNA report (6) contains specific and detailed examples of (1) what some employers consider to be an excessive level of absenteeism; (2) absence control measures; (3) special incentives for good attendance; and (4) progressive disciplinary systems. The BNA report also provides statistics concerning how many firms are engaging in various strategies to increase their employees' attendance. The following are some of the highlights of the BNA survey:

1. Although a system of progressive discipline has been set up by more than 9 out of 10 employers to handle attendance problems, fewer companies—43 pct—have a written rule or policy defining excessive absence.

2. One quarter of the firms have developed new programs such as job enrichment, worker participation programs, and flexible hours to improve motivation, productivity, and, in all likelihood, absence and turnover rates as well.

3. Supervisors are trained in absence control by 4 out of 10 companies, and 16 pct of the firms evaluate their supervisors, in part, on the absence rates of employees in their charge.

4. Motivational programs have been developed by 4 out of 10 responding companies to promote good attendance. Almost half of those employers (45 pct) pay employees for unused sick leave; nearly 4 out of 10 offer awards or publicity for employees with the best attendance records; 27 pct promote better attendance through pay inserts or newsletter articles; and one out of five financially reward employees who achieve attendance standards.

5. Disciplinary action and employee counseling are considered the most effective methods for curbing employee absence by the largest group of respondents. Of the 100 respondents who offer comments on what they have found to be the most effective method of curbing unnecessary employee absences, the largest group—more than a third—cite disciplinary measures or discharge as the key. Nearly as many—about 30 pct—attest to the effectiveness of counseling employees as

problems develop. Ten percent found that establishing a formal policy and a consistently administered program made the most difference in their absence rates, and another 10 pct stress the supervisor's role as the most important element, attributing improved absence records to supervisory training, awareness, and rapport with employees.

The BNA survey included many types of business and nonbusiness organizations. The category that appears closest to the mining industry in terms of the work force and working conditions is manufacturing firms. About half of the companies in the survey fall into this category. The following statistics indicate the proportion of manufacturing firms that use various methods for controlling absenteeism: 99 pct have a progressive disciplinary system for employees with attendance problems; 54 pct have a written rule or policy describing excessive absence; 52 pct give supervisors training in absence control; 25 pct evaluate supervisors' performance on the basis of subordinates' absence rates; and 53 pct have taken special measures to encourage good attendance.

Of the manufacturing firms that have taken special measures, the proportion using various types of incentives and/or interventions are 39 pct pay for unused sick leave; 47 pct give employees with the best attendance records some form of recognition; 31 pct use motivational pay inserts, posters, or newsletter articles; 28 pct provide financial rewards for meeting attendance standards; and 6 pct give additional paid vacation leave for meeting attendance goals.

These percentages suggest that a substantial proportion of the absenteeism control plans currently in use do not contain features that research suggests would make them more effective. Most notably, 46 pct do not have a written policy describing excessive absence; 48 pct do not involve giving supervisors training in absence control; and 47 pct do not involve using some form of positive incentive to encourage good attendance. It appears that the approach being used by many employers to control absenteeism is limited solely to the use of various forms of punishment for noncompliance with the attendance rules. The research evidence reviewed previously suggests that better plans can be devised. Based on this research and what is known about the coal mining industry, the following program for improving miners attendance is proposed.

## PROGRAM FOR IMPROVING MINERS ATTENDANCE

The usual reasons for an attendance program are to reduce interruptions to production, decrease labor costs, and to improve safety. An attendance program, which produces high, consistent, and predictable attendance, helps the company achieve these goals. If attendance is not perfect, but safety and productivity are high then the goals may be considered met. Furthermore, worker satisfaction is an important goal in its own right. A system that gets excellent attendance at the cost of lowered worker satisfaction may alienate workers, causing a variety of undesirable outcomes. The system should help foster effective work habits and positive work attitudes because such habits and attitudes are crucial determinants of a mine operation's productivity and safety.

In order to develop the most effective absenteeism program for a particular mine site, one should consider using basic attendance control procedures which have been shown to be effective in other situations, and tailor them for the needs and constraints of a particular mine.

According to Goodman (10), the major determinants of absenteeism vary significantly from one group of miners to another. Furthermore, the best strategies for reducing absenteeism vary with the causes of the absenteeism, making it important to choose strategies that fit the major causes at a particular mine.

On the basis of the research evidence concerning characteristics of effective absence control measures, the following four stage program for improving miners attendance is recommended:<sup>7</sup>

1. Measure and display data.
2. State goals and absenteeism policy.

<sup>7</sup> For a similar analysis of absenteeism control plans see Kempen (22). Stages like this may be used to deal with a range of human behaviors in an organizational setting. It is beyond the scope of the present report to describe such practices. Those interested in using behavior analysis to solve other problems should see Malott (30) and Sulzer-Azaroff (48).

3. Develop and implement attendance promotion program.

4. Recycle.

Each of these stages are discussed in detail.

## MEASURE AND DISPLAY DATA

The first stage describes various strategies used to collect and analyze data on absenteeism. It is a very important prerequisite to the stages that follow. In order to get an accurate idea of the nature of the absenteeism or to see if there even is an absenteeism problem, one must examine the absenteeism data. The data will reveal whether the problem is with a few individuals, mine wide, or if the problem is restricted to a particular section, shift, or unique subpopulation of workers. A graphic representation of the data across time also allows one to see if new attendance control measures are having any impact.

There are a number of useful ways to examine the data, each having strengths and limitations. For example, the data may be broken into excused versus unexcused absences. It may also be informative to look for seasonal or temporal trends in the data, e.g., breakdowns by day of the week, or other significant events like the opening of hunting season. Another useful method to display attendance is to make charts of the number of days on the job per worker. Displays that aggregate attendance over time or over groups of people often help to reveal a more complete picture of the major causes of absenteeism, thus improving one's ability to select appropriate strategies for improving attendance. These aggregate displays will also allow one to get a better picture of the effects of a given intervention.

A good source of information about discerning trends and patterns in the rates of miner absenteeism (perhaps for comparison purposes) is Goodman's report (10), which presents several types of breakdowns of the absenteeism that occurred at each of 15 coal mines during the early 1980's. Linear modeling, a procedure described in the appendix to this report, is another valuable aid in understanding the causes of absenteeism.

The charts constructed to track attendance patterns should contain tallies of all absences for whatever reason. If distinctions are made between different types of absences (e.g., excused and unexcused) the meaning of the tallies will be obscured by the often subjective nature of making the distinction. Also, it is preferable to chart absences rather than attendance because it is simply unwieldy to check off every attending miner every day, and the resulting chart would be too cluttered for easy analysis. As long as the absence measure used for the tallies is a mirror image of simple attendance, the charts should be both unambiguous and easy to maintain.

### Individual Level Charts

A simple, but effective mode of examining absences is to create a chart that displays the absences per worker per crew (worker absence chart). A tally of this sort may be updated daily by simply placing an "X" above any worker who is absent during that recording period. Blank recording forms can be copied for use by administrators or supervisors. Figure 2 shows a hypothetical example of this sort of display.

Each worker's chart should be updated daily as the behavior of interest (absence) occurs. As the X's accumulate, patterns may become evident that reveal problems needing prompt remedial action. For instance, one would interpret the situation differently if the pattern seen in figure 2 occurred by March rather than in June. Recording absences as they occur is

important in order to prevent minor problems from becoming major problems.

Figure 3 shows another pattern of absences which may lead to different decisions about remediation than the decisions made based on the pattern in figure 2. An absence pattern like that shown in figure 2 might lead one to suspect that one or two workers have an absence problem and that the work section is otherwise relatively conducive to attendance for the rest of the crew. Figure 3, on the other hand, might prompt a search for problems with the particular working conditions, which seems to be affecting the attendance of the entire crew (including physical factors and supervision) on this section, or it might stimulate development of a positive incentive plan for attendance.

Charts like the ones shown in figures 2 and 3 can also use color codes or lines to indicate at what point a worker is in need of help or remedial action. These charts can be an aid in catching problems before they cause production losses or safety hazards.

For some purposes it may be useful to look at the durations of each employee's absences. For example, absences owing to an accident may cause a number of consecutive days off the job. Often it is the case that severe illness and injury will cause a long period of consecutive days off the job. A lack of motivation, on the other hand, might result in a great number of absences of short duration. Thus, different patterns of absences may be interpreted differently. An interesting series of graphs could be made on number of absences and duration of absences for individual or group data. This sort of fine-grain analysis may help one see aspects of attendance which are important to production and safety. These charts will be described in later sections. At this point, it should be pointed out that they may be useful as part of the procedure for measuring and displaying data.

An attendance chart might also include information about the job classification of the miners present or absent. Information of this type might be useful for those using attendance records to help plan replacements for absent workers or when evaluating the effect of absences. The important thing in using charts to evaluate attendance is to make sure it views the aspect of the importance of attendance to the mine and the program.

### Aggregating Across Individuals

Another chart that can be very helpful in assessing the effectiveness of a program is a frequency attendance chart. This chart is also very easy to prepare and use. In order to prepare this chart, simply label the horizontal axis with successive calendar days. For easy analysis, use all of the days of the week even if work is done only on weekdays. Label the vertical axis with workers on the job. Then, to fill out the chart, take the total count of attendance for that day and put a dot at the appropriate place. This chart can be used mine wide or by section depending upon the aspect of attendance that is important. As with the worker absence chart, charting on a daily basis is easier and more effective than tallying a number of days all at once. Trying to chart 3 months of data at once may seem like a prohibitively time consuming and difficult task, while consistent daily recording is a fairly easy job. Moreover, the information obtained as the data is charted on a daily basis can be used immediately to correct any impending problems.

Looking at 6 months of recorded data can yield valuable information about the nature of the absenteeism problem, days with low attendance, and possible causes of absences. A pointer or cane may be placed over significant changes in the

## Worker absences

## Number of absences

11								
10								
9								
8								
7								
6								
5								
4								
3								
2								
1	Tom B.	X						
	Bob R.							
	Mark C.	X	X	X	X			
	Bob P.	X						
	Linda W.	X	X					
	Richard U.	X						
	Jim P.							
	Jim R.	X	X	X	X			
	George B.							
	Bill R.	X						

## Workers

Recording period: Jan 1 to June 30

Figure 2.—Absences recorded over 6-month period for hypothetical mining crew.

## Worker absences

Number of absences

Tom B.									
Bob R.									
Mark C.			X						
			X						
			X						
					X				
				X	X				
			X	X	X	X			
			X	X	X	X	X		
								X	
								X	
									X

### Workers

Recording period: Jan 1 to June 30

Figure 3.—Absences recorded over same period as figure 2 for crew with different absence patterns.

attendance program or important events. The correlation between the events and changes in attendance can then become graphically apparent. Most importantly, a 6-month graph can show how consistently attendance rates were at the desired levels. Consistent attendance rates should be sought in addition to high overall attendance rates. Figure 4 shows how a frequency attendance chart might look.

After implementing a new procedure to improve attendance, this measurement and display stage of the plan should continue. Then in 2 or 3 months, when enough data is collected to ensure that seasonal or random fluctuations are not in play, one can evaluate the effectiveness of the new policy or procedure. An even shorter time period may be used if past records are charted and used for analysis. Looking at corresponding times of the year can be especially valuable when doing a historical comparison.

It is impossible to evaluate and possibly even implement a change in an attendance program if one does not gather and analyze enough absenteeism data to get a good baseline. As the attendance program progresses through the other stages, this measurement and display continues as an integral part of the entire program. It will be used through the successive stages of program development and represents one of the most important elements of the program.

In summary, measuring and displaying data is an important step in an absence control program that should include the following tasks:

- Chart the aspect of attendance of concern to you.
- Look for seasonal or other trends in the data.
- Chart on a daily basis.
- Various charts can be used. For example, total attendance can be looked at with frequency attendance charts or individual levels of attendance can be viewed with worker attendance charts or a daily attendance record.

## STATE GOALS AND ABSENTEEISM POLICY

The formation of goals and policy statements is viewed as an important prerequisite to the stages that follow. Further, it is important to tell the workers what is happening both from an ethical standpoint and to avoid conflicts owing to lack of information. Workers will accept changes more readily (even positive ones) if they are informed of the changes before they occur. Last, the mere act of informing the workers of the rules can result in better attendance.

### Goal Setting

The importance of setting goals about attendance cannot be overstated. Before attempting to solve any problems, decide upon what success will mean. The goal should be beneficial to both the mine and the workers, and it should be reasonable. Being reasonable means that one should aim for modest gains—ones that are likely to be perceived as attainable. If the goals are easy to attain, then the chances of success are enhanced and the entire work force is less likely to become disenchanted with the program.

At this point, management may want to involve supervisors and labor by establishing a committee with representatives from both groups. Input from various segments of the work force can give management useful inputs on establishing goals. This committee can also help oversee the program as it is developed, implemented, and evaluated. The committee can be useful in representing the needs of the workers and in keeping them informed of the company goals. This can be a useful aid

in securing worker acceptance and compliance to changes in rules or procedures.

The first step in establishing an attendance goal is to decide why absenteeism is a problem. In other words, state the factors that lead the company to work on increasing consistent attendance. Make a list of the benefits to the company and to the miners. As mentioned earlier in the text, these reasons may be in terms of productivity, job security, reducing labor costs, safety, planning work, etc. Explicitly writing out these reasons for an attendance goal will help guide decisions in further interventions. For some goals, an attendance program may not be an entirely adequate answer. Perhaps positive incentives for some aspect of production will be in order, or a novel work plan may emerge as a better solution. In any case, a written statement of the reasons should be part of the goals as these will help guide future decisions.

The next step in establishing an attendance goal is to state the level of attendance that will be considered exemplary in terms of frequency of attendance. The relevant dimension for measuring attendance will be selected according to the nature of the chosen goal. It might be the rate of attendance per day, rate per week, absences per day, absences per worker, or whatever dimensions are most applicable to the stated goals. Remember it is important for the goal to be reasonable and beneficial for both the company and the miners.

The last part of this goal setting procedure is one that can start having an impact on the attendance pattern. Inform the miners of the goals. This is important for a few reasons. First, it provides honest information about why this program is important for them and for the mine. If people see reasons for attendance they may use this information to change their beliefs and values about attendance. Second, it will help counter resistance to the program by getting people ready for change. If workers see a program as unfair, they have a chance to voice their opinions and management has a chance to counter these objections openly. Moreover, if there are valid objections to the goals, then management has a chance to make adjustments before negative forces act to sabotage the whole program. Stating the goals of the attendance promotion program can help ensure that the subsequent interventions will succeed. Allow a month's notice before new procedures begin so that employees will be prepared for the changes.

### Negative Sanctions

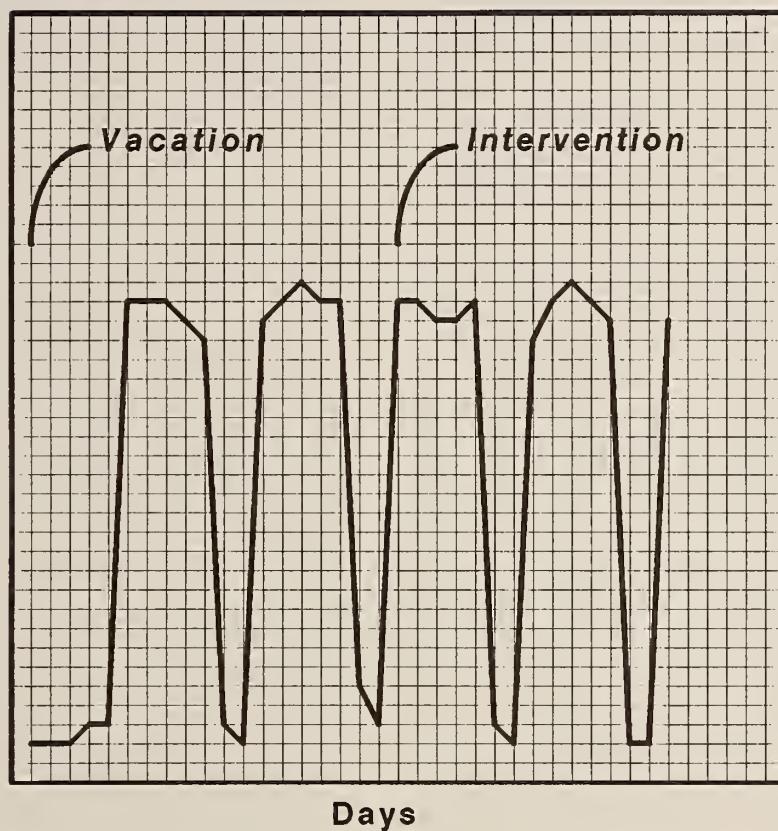
An employer needs to respond to problems quickly. Yet, employers sometimes attack the problem without sufficient forethought. Taking vindictive action or punitive measures may actually exacerbate the problem and could lead to a negative backlash among workers. A plan that is most useful is one that intervenes in stages in such a way as to help workers perform better. A system should bring out the best in workers and not be used solely as a club that threatens them for attendance transgressions. When punitive measures must be used, they should be applied consistently, and adhere to the rules of the program. Used in this way, the punishment will be more effective, have less negative backlash, and will help set the standards for the limits of acceptable attendance.

Negative sanctions usually are in the form of disciplinary actions that go from formal warnings, through suspensions without pay, to employment termination. The last negative sanction will eliminate workers who are not amenable to the absenteeism policies.

An essential part of the use of negative sanctions is that the specifics of each negative sanction be added to the

## Frequency of attendance

Number of workers  
on the job



Recording period: Jan 1 to June 30

Figure 4.—Attendance chart for hypothetical 6-month period with significant events indicated.

absenteeism policy statement. Then, ensure that the workers know exactly what these sanctions are and how they accrue. This has two purposes: first, it will help keep dissent down if the sanctions are applied, and second, it will inform workers as to what behaviors are not acceptable and the sanctions that will follow them. The latter may help reduce absenteeism by allowing miners to make an informed decision about the consequences of absenteeism.

Premature use of negative sanctions can cause counter-productive behaviors. For example, workers who experience negative sanctions for absenteeism might be more prone to things like vandalism, sabotage, or slower work habits. Nicholson's (36) study suggests the increased use of negative sanctions for absenteeism may cause employees to find ways to circumvent the disciplinary system, leaving the overall rate of attendance unchanged.

Just as it is important to avoid delivering sanctions too soon, it is also important that there be no delay between when a worker meets the criterion for disciplinary action and the administration of the negative sanction. For punishment to be effective it should be given out consistently and immediately after the transgressive behaviors.

In order to be most effective, negative sanctions should be used only at times specified in the absence control policy, and used in a fair and consistent manner (for all occasions and for all workers). It is hoped that measures in an attendance promotion program will reduce the need to apply negative sanctions.

In summary, this step is a prerequisite. It should be done even if there are currently no major absenteeism problems. Workers will know what is expected and should problems arise management will have recourse to act in a remediative manner. The policy statement should be precise and understandable. All workers should periodically be made aware of it. Specifically, this policy statement should explain what types of absences are excusable and not excusable, procedures for reporting off, and consequences for violating the rules. Especially during the initial phases, the absenteeism program is likely to undergo some changes as rules are added, deleted, or modified. Therefore, this stage should be viewed as a continuing process.

In summary, it is recommended that the absence control program stage of stating the goals and absenteeism policy should include the following characteristics:

- Involve supervisors and labor by utilizing a committee.
- Goals should be beneficial to both the company and the employee.
- Goal statements should include the reasons why good attendance is important (e.g., job security, reducing labor costs, safety, planning work, etc.).
- The goal should be reasonably attainable to help ensure success.
- State the specific level of attendance that has been targeted as the goal.

## DEVELOP AND IMPLEMENT ATTENDANCE PROMOTION PROGRAM

The development and implementation of an attendance plan is the core stage. In order to engender a high level of support and acceptance for the program, it should attempt positive interventions before negative ones, and should intervene only to the extent necessary. Beyond this, it is difficult to formulate recommendations that have widespread applicability. In order to specify the particular details of a program for

a specific mine site, one must take into consideration other characteristics of the company and the mine workforce.

Several specific strategies for improving attendance were reviewed in the first half of this report. Depending on what the major causes of the absenteeism at a particular mine are, some of these strategies will be more effective than others. However, two of these strategies appear to be advisable for almost any mine experiencing high absenteeism because of low attendance motivation. These strategies are (1) supervisory interventions and (2) incentive programs. The components of each of these two strategies are presented.

### Supervisory Intervention

Three major things immediate supervisors can do to help eliminate aberrant absenteeism are (1) publicly chart attendance, (2) treat absent workers in a just and reasonable manner, and (3) monitor and refer employees whose poor attendance may reflect off-the-job problems.

The supervisor is the first line of defense against problem absenteeism. In order to perform these measures correctly, the supervisor should be given training on procedures for reducing absenteeism and should be given feedback on dealing with the employees. Giving a supervisor feedback requires periodic monitoring of the supervisor's behavior concerned with carrying out the three approaches to supervisory intervention.

### Publicly Chart Attendance

A crew supervisor can be shown how to fill out one of the blank charts described in stage one. These charts should be filled out daily and publicly posted for the crew to see. Charts make it easier for individuals to see where they are with respect to company goals and policies. As previously mentioned, Miller (31) found that publicly posting each employee's attendance record significantly reduced absenteeism from 14 to 5.7 pct. Using this technique should be seen as a method of communicating information with the employees. The supervisors should refrain from making disparaging remarks about absences and use the graphic presentation only to help the workers see what is going on with respect to their absences. Figure 5 shows a record that can be very easy for a supervisor to fill out on a daily basis. The supervisor simply puts a mark across from the name of the employee on days worked. Alternatively, one might want to chart absences, i.e., the opposite of attendance. Figure 6 (based on absences) represents a different method of portraying the data on which figure 5 is based. Because days of absence are much less numerous than days of attendance, individuals' absence patterns and frequencies are somewhat easier to see in figure 6 than in figure 5.

Workers need to be informed about the nature of these charts. It should be made clear that these charts are not indexes of unexcused absenteeism. They are simply devices for looking at the patterns of attendance at the mine. The charts may help workers to realize where they are with respect to goals or positive or negative sanctions.

These charts represent a different (less refined) level of analysis than the records kept by the mine office. For example, management records may categorize absences according to various reasons, while the supervisor is mainly interested in a count of people on the job.

While more than 1 month may be displayed at a time, each chart produced by a supervisor should probably contain about 1 month's attendance data. Supervisors must consistently record attendance each day on the public chart. It takes

## Daily attendance record

	H	S	S	S	S	S	S	S	S	S	S	S	S	S
Tom B.	X X X		X X X	X X		X X X X X				X X X		X X	X X	
Richard U.	X X X		X X X	X X		X X X X X				X X X X X		X X	X X	
Bob R.	X X X		X X X	X X		X X X X X				X X X X X		X X	X X	
Bill R.	X X X		X X X	X X		X X X X X				X X X X		X	X	
Bob P.	X X		X X X	X X		X X X X				X X X X		X X	X X	
Jim P.	X X X		X X X	X X		X X X X X				X X		X X	X X	
Mark C.	X X X		X X X	X X		X X X X X				X X X X		X X	X X	
Linda W.	X X X		X X X	X X		X X X X X				X X X X X		X X	X X	
George B.	X X X		X X X	X X		X X X				X		X X	X X	
Jim R.	X X X		X X X	X X		X X X X X				X X X X X		X X	X X	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	15	16	17	18	19	20	21	22	23	24	25	26	27	28
	29	30	31											

Month: January, 19 85

Figure 5.—Chart showing daily attendance recording for hypothetical mine crew during 1-month period.

## Daily absence record

	H	S S		S S		S S		S S	
Tom B.								X X	
Richard U.									
Bob R.									
Bill R.				X			X X		X X
Bob P.	X				X	X			
Jim P.						X X X			
Mark C.						X			
Linda W.									X
George B.					X X		X X		
Jim R.									
	1	2	3	4	5	6	7	8	9
	10	11	12	13	14	15	16	17	18
	19	20	21	22	23	24	25	26	27
	28	29	30	31					

Month: January, 1985

Figure 6.—Same chart as figure 5, only with absences rather than attendance indicated.

only a few minutes, at most, for the supervisor to place a check or other mark in the appropriate box on the tally. This is one of the easiest interventions, involving only minor changes to existing procedures. It can also enhance the effectiveness of the other interventions. Therefore, it is one of the first things to consider in an attendance promotion program.

### Treating Employees Reasonably

Supervisors should not attempt to punish the worker by word or deed. Every negative sanction should already be clearly stated in the policy statement from stage two. Attempts by supervisors to deliver punishments outside of the formal sanctions in this policy can have strong negative consequences and might lead to a more intractable absenteeism problem. However, communicating policy to the worker can be important. Supervisors must know how to warn of impending negative sanctions without the warning itself seeming like a punishment. One way to do this is to incorporate the warning into an expression of concern for the worker's welfare. This is a tricky point. The supervisor could appear to be threatening the employee when it is important that the supervisor be seen as giving information to help the employee do well at that mine. It is important, for the success of the attendance promotion program, that supervisors be properly trained as to how and when to give this sort of informative feedback.

A supervisor who makes value judgments about a worker's morals or personality is less likely to communicate as effectively as one who clearly states the consequences of the worker's behavior in a factual manner. A statement such as, "What is wrong with you? You have got to show up for work or you are going to lose your job, buddy" is loaded with negative meanings. It is actually a form of punishment, which is likely to cause a number of undesired reactions. A more emotionally neutral factual statement can communicate the same information and have a better effect e.g., "John, I am concerned about your attendance because the company rules only allow one more day of unexcused absence. I'd hate to lose you because you are a good worker, but I know that management strictly enforces the absenteeism policy. So make sure you don't miss any more work." This type of emotionally neutral informative feedback, if actually true, can be a step in the direction of clear information without alienating a worker.

When the worker returns after an absence, the supervisor should first welcome the person back. Informative feedback should not be given until later at a time when the employee will be more receptive to this type of communication. Advise supervisors to give feedback before a negative sanction is applied, but not when the person first returns to work and not in the potentially embarrassing presence of fellow crew members.

### Monitor and Refer Employees For Problems

Many times, a supervisor is confronted with a relatively small number of habitually absent miners. Habitual absentees are apt to be experiencing some type of off-the-job problems. Their absenteeism may be the result of alcoholism, drug abuse, emotional distress, or family related problems. In such cases, it may be helpful to both the employer and the employee if the individual gets appropriate counseling or some other type of assistance to help cope with the problem.

It is important that persons with certain types of problems, (e.g., alcoholism), be helped before their problem progresses to the point of being irreversible. Working daily with the employee, the supervisor is in a good position to spot employees with off-the-job problems affecting their work.

Therefore, the immediate supervisor may be in the best position to initially refer employees for help. However, in order for supervisors to serve this function effectively, it is important that they receive appropriate training. One needs to avoid either (1) neglecting those who could be helped by referrals (and these people may often deny their problems) or (2) sending people for help who do not need it. Many agencies, offering EAP services, will provide training workshops on how to identify and refer employees with problems. See Campbell (7) and Goodman (11) for more information about employee assistance programs for coal miners.

### Summary

Supervisors have a primary role because they work directly with the miners and because they are involved in virtually any intervention. Supervisors may need some training and feedback in order to properly carry out these recommendations.

#### *Recommendations for Publicly Charting Attendance:*

- Charts should be filled out daily.
- Publicly post charts where the crew can see them.
- Make it easy for the supervisor to fill out the chart.
- Inform the miners that the charts are not to show unexcused absences, but to show how well they are doing.
- A month's worth of data is an appropriate time frame for each chart.

#### *Recommendations for Giving Reasonable Feedback:*

- Set the tone i.e., why attendance is important.
- Communicate honestly avoiding value judgments.
- Do not add punishments to the ones present in absenteeism policy.
- When the worker returns after an absence the supervisor should first welcome the employee back.
- Remind employees of impending negative sanctions before the sanctions are applied.
- Advise workers with attendance problems in private not in front of fellow workers.

#### *Referring employees with personal problems*

Some miners are frequently absent because of personal problems that are unrelated to the job. In such cases, it may help both employee and employer if these miners receive counseling or other assistance. Many agencies offer training for supervisors on how to identify employees with personal problems and how to motivate them to seek appropriate help.

### Positive Incentives

If a problem still exists, as indicated by the ongoing attendance recording activity, the next step in the attendance promotion program is to implement a positive incentive system. There are a few things to remember about a positive incentive program. First, a criterion for success should be established. Workers need to have specific information on what will earn them the reward. It is in the best interest of the company and the worker to not make this criterion too difficult. For example, if workers are encouraged to attend work when they are actually sick, they may become more ill or help spread the illness among the healthy part of the work force. Moreover, making the criterion for success too high will cause the system to be less effective.

Positive incentive programs require careful planning. Positive incentive programs can be easy to implement and effective, but if they are not planned and used correctly they will fail and could even cause other problems to arise. See Goodman (12) for a discussion of common inadequacies in the design of incentive plans for miners.

The following example of a positive incentive system used by a mine to increase safety illustrates some problems that may arise. A mine provided expensive awards to each member of a crew if no one in the crew suffered a lost time accident for a year. As a result, for the first 6 months there was a reduction in accidents. However, the rate of accidents increased sharply during the second 6 months.

Why might something like this occur? The first part of the year the whole crew might have been more vigilant and more inclined to watch out for each other. But as the year went on, it was inevitable that a few accidents were bound to occur. After an accident occurred to anyone on a crew, the opportunity to earn the reward was removed for the entire crew. As the year progressed more and more crews became eliminated from the available rewards. Thus, the overall impact the rewards had on motivating safe behavior dwindled to almost nothing by the end of the first 6 months. It was not because positive incentives did not work, but because the system was structured so that over time the rewards were no longer available to the majority of the workforce. Here are some suggestions to consider when designing a positive incentive program for attendance.

### Size and Timing of Rewards

Most research has shown that small rewards given frequently have more effect than large rewards given after a long period of time (Malott (30), Morse (33), Sulzer-Azaroff (48)). This suggests that giving a small reward, like a sticker or five dollars, every 2 months for not missing more than 1 day is better than giving a watch or 50 dollars for perfect attendance over a year. In a positive incentive program, the criterion for success should be within reach and the rewards given promptly. For example, if perfect attendance is required for 6 months then this will have no effect on a person who misses work the second day of the program. Furthermore, this program will only impact the few workers with good attendance and not the general population of miners. A better program will have an effect on a wider range of employees.

A good way to administer a positive incentive system is by granting a reward or privilege each month for last month's attendance. This short time span increases a worker's opportunities to succeed. It encourages good attendance at the start of each new month. The rewards or privileges will work best if they are considered small tokens of appreciation, that is, things that workers will not feel too badly about if missed for 1 month.

### Choosing Criterion

When setting the criterion for such a system, establish a baseline by counting days on the job over the preceding month or over the same time period a year ago and then use a slightly higher number of days as the goal. With this criterion, a chart of the total days on the job as seen in figure 7 can be useful.

The chart in figure 7 has no data on the particular days when an employee is absent or on the job. The supervisor simply puts an "X" over the workers name if present that day. A criterion line is present to show if a worker achieves the goal for that month. By looking at the chart on any day a worker can see graphically how close he or she is to the goal by the spaces between the last "X" and the criterion line. This chart might be used in conjunction with the days actually attended as described in the discussion of supervisory intervention.

In order for an incentive to effectively motivate, it is critical that employees have some amount of control over the performance required to attain the reward. Lawler (27) argues that the more control the employee has over achieving the

performance level required to receive the reward, the greater is the reward's motivating power. Therefore, a positive incentive program that makes each employee's reward contingent on the basis of one's own attendance record will be more effective than a program that makes each employee's reward contingent on the basis of the overall crew's level of attendance.<sup>8</sup>

Rewarding a high frequency of on the job behavior, with a bonus, may change the employee's focus from meeting a minimum acceptable standard to the goal of exemplary attendance. It will also eliminate some of the tricky evaluations of excused versus unexcused absences. Using frequency of attendance, with no other criterion, allows for the consistent administration of the program.

### Choosing Reward

The type of reward used in the program will have a large impact on the outcome of the program. There is an important difference between the terms reward and reinforcer. The term reward has been used to indicate something offered or given for some service or attainment. The definition says nothing about the behavior one would be interested in increasing (in this case, attendance). A reward may be given to show gratitude for a job well done with no concern for future behavior. On the other hand, a reinforcer is a stimulus which increases future probability of the behaviors it follows. If a reward is given that does not increase attendance behavior (when it is appropriately applied) then that reward is not a reinforcer. If this happens, one should consider changing the reward to something that will increase the desired behavior.

Here are three reasons why a particular reward may not function to reinforce a behavior. (1) Workers, who do not earn the reward, may tease the ones who do causing a loss of desire for the reward.<sup>9</sup> (2) Some miners may view the reward as a meaningless gratuity. A particular worker may just not value a reward even though others do. (3) After a person earns a particular reward, one may be satiated with that object and no longer desire it (e.g., if a person is not a collector, one can only use so many belt buckles).

What are some of the rewards that could be used as reinforcers for good attendance? As mentioned before, small reinforcers given frequently have a larger impact on behavior than large reinforcers given infrequently. Here are some of the things that have been offered to employees as incentives for various achievements: stickers, patches, ball caps, belt buckles, penknives, bonuses, public commendations, written commendations, certificates, and stock in the company. Although all of these may be used as rewards in positive incentive programs, privileges may serve better as reinforcers because satiation is not as much of a problem (e.g., a number of belt buckles may accumulate, but each week the right to do something in a preferred way is used up).

How might some of these privileges work? One might, for example, give an employee paid time off at preferred times to reinforce good attendance.<sup>10</sup> The question might arise, why should one give a worker time off when that is what the

<sup>8</sup> For some purposes (e.g., increasing productivity), group level incentive plans for miners may be preferable to individual level plans. Group contingencies may be useful where (1) the individual's level of performance is not amenable to measurement, (2) good measures of the group's performance are readily available (e.g., the tonnage produced by face crews during a week), and (3) teamwork is needed to accomplish the goal, as group incentives may shift group norms about the importance of productivity and cooperation.

<sup>9</sup> Rothlesberger (43) landmark study at Western Electric illustrates how group norms can mitigate management's performance goals.

<sup>10</sup> Indeed, Goodman's (10) study suggests that most miners place a high value on paid time off. Most of those interviewed said they would rather have more time off than more money.

## Total days on the job

### Attendance days

	Tom B.	Richard W.	Bob R.	Bill R.	Bob P.	Jim P.	Mark C.	Linda W.	George B.	Jim R.	Criterion for bonus
31											
30											
29											
28											
27											
26											
25											
24											
23											
22		X	X							X	
21		X	X				X	X		X	
20	X	X	X				X	X		X	
19	X	X	X	X	X	X	X	X		X	
18	X	X	X	X	X	X	X	X	X	X	
17	X	X	X	X	X	X	X	X	X	X	
16	X	X	X	X	X	X	X	X	X	X	
15	X	X	X	X	X	X	X	X	X	X	
14	X	X	X	X	X	X	X	X	X	X	
13	X	X	X	X	X	X	X	X	X	X	
12	X	X	X	X	X	X	X	X	X	X	
11	X	X	X	X	X	X	X	X	X	X	
10	X	X	X	X	X	X	X	X	X	X	
9	X	X	X	X	X	X	X	X	X	X	
8	X	X	X	X	X	X	X	X	X	X	
7	X	X	X	X	X	X	X	X	X	X	
6	X	X	X	X	X	X	X	X	X	X	
5	X	X	X	X	X	X	X	X	X	X	
4	X	X	X	X	X	X	X	X	X	X	
3	X	X	X	X	X	X	X	X	X	X	
2	X	X	X	X	X	X	X	X	X	X	
1	X	X	X	X	X	X	X	X	X	X	

Workers

Month: January

Figure 7.—Attendance tally chart for the same period as figure 5. The horizontal line at 21 days indicates the criterion level.

program is trying to discourage? The answer is the purpose of the program is not merely to have higher attendance, but to have more predictable attendance so that absences can be planned for and will therefore not be as disruptive.

Most managers want attendance patterns that help them achieve a higher level of production, efficiency, and better safety. If it is known in advance that a person will be off the job because of a bonus day, one has a better chance of getting an experienced replacement for the absent miner. One should make provisions to spell off workers who hold critical jobs. In this regard, days when absences are liable to be high anyway (e.g., hunting season, fishing season, or holiday seasons) may be designated as bonus days for exemplary attendance rates at other times of the year. Similarly, extended vacation periods or the right to leave work early, where feasible, can have a positive impact on attendance behavior.

Finally, since everyone has different values and needs, miners might choose from a personal incentive menu. Points might be earned and later exchanged for any number of things or privileges according to the miner's own particular desires.

### Scheduling Reward

It is also very important how the rewards are delivered and made available. In order for a reward to be an effective reinforcer of a high rate of attendance, the reward must be given contingent upon that behavior. This means if a bonus is used to increase attendance, then a high rate of attendance must first occur before the bonus is given. To ensure that a particular reward is contingent upon the desired behaviors, one must (1) be explicit in the criterion that will earn the reward and (2) give the reward soon after the behavior of interest.

Giving rewards every day as the miner comes to work is not usually possible. But, some sort of indicator of progress toward the reward can be given immediately on a daily basis. This is one of the reasons the charts and graphs described above are of such importance. Every time a person comes to work a tick mark is placed above one's name and the progress toward the attendance goal that will earn a specified reward can be seen. Thus, charts or point systems can be used as small immediate consequences for desired behaviors. This helps to bridge the gap in time between behaviors and the receipt of rewards, and is important even if the time between behavior and reinforcement is only a week. The public display of attendance data can be a valuable aid to miners interested in meeting the established criterion. Anything that can be done to help them see progress toward their goal will be useful.

Vacation days must be treated carefully when implementing a positive incentive program. Taking these days is certainly the miners' right, but a last-minute decision to take a vacation can be as disruptive as an unanticipated absence. To reduce this problem, a time criterion for vacation days can be established. Vacation days, if approved a specific period of time in advance, might be treated the same as a day on the job for the purposes of the incentive plan. Using this method, a vacation day not approved in advance would not count toward the good attendance bonus, although it would still officially be an excused absence. In a similar vein, an absence due to illness would also be considered to be an excused absence, but would not count toward the attendance bonus. This system would allow for vacation days, while keeping the integrity of the attendance incentive plan intact.

After a positive incentive program is in effect it is important to look at the data for changes, which may not have been anticipated. It is impossible to know all of the ramifications a priori for a particular site. In the examples given above, the total number of days of attendance was used as a criterion for earning the reward. Workers might start scheduling their

absences around blocks of time so that they maximize the times they can earn the rewards. These unanticipated changes may or may not be useful to the mining operation. Therefore, when a program is established, first allow some time to let any imposed variability in the rates of attendance stabilize. Then, examine the data carefully for unanticipated changes in attendance patterns. Adjustments may need to be made to the system if these unanticipated changes are counterproductive.

There are several design aspects to consider when incorporating positive incentives into the absence control program:

- Design the system to help you reach the attendance goals you want. Establish a specific criterion of success for earning the reward.
- Find a baseline by looking at the data from last month or the same time period a year ago.
- A system that rewards small, but significant gains is more likely to succeed than one which attempts to get perfect attendance.
- Use small rewards frequently, say on a monthly basis.
- In order to provide for some immediate reinforcement, use charts to show daily attendance.
- If a reward is given that does not increase attendance then that reward is not a reinforcer for attendance. Change it to something that will increase attendance.
- Using unadjusted attendance rates helps remove ambiguities about the meaning of the numbers. This allows for a more consistent administration of the program.
- Some possible rewards that could be used as reinforcers for good attendance include: stickers, patches, ball caps, belt buckles, penknives, public commendations, written commendations, certificates, stock in the company, money, and privileges.
- Privileges, like paid time off, have the advantage that they must be earned anew each month.

## RECYCLE

The last stage in this program is to recycle. Recycling means to look at what is happening and evaluate the effectiveness of the program. If goals are not being met or if unexpected counterproductive behaviors have emerged, then changes need to be made. If goals are on target then make sure that the supervisory staff keeps administering the program consistently. This stage of the program is important since it will help the attendance promotion program to evolve to fit particular needs of specific sites. It will also help maintain gains from the intervention. If an absenteeism committee was formed, it should be involved in this recycling and evaluation process.

To recycle, take an in-depth look at the entire system, the policies, absenteeism problem, goals, data, and views of workers. Go back to stage one and check each stage to see if anything can be improved. In order to get a more thorough analysis of what is going on with respect to the absenteeism program, one might perform a linear modeling procedure. For details on the specifics of such a procedure see the appendix to this report.

In this in-depth review one should look at some critical questions. For example: Have positive changes occurred due to interventions? Can more gains be realized? Is the system being followed by supervisors? If the answer to the last question is yes then reward the supervisors.

If the supervisors are not following the system then consider these suggestions. First, if the supervisors are not effective get them to be consistent with the program. For example, set up a system to monitor their behavior and reward

the supervisors for staying with the plan. Second, find out if the goals are reasonable. The goals may not be stated in terms of benefit for the organization and the worker. In the latter case, review the goals and make sure they are reasonable.

However, if these supervisors, who are not following the attendance program's procedures, are effective in promoting the type of attendance desired then consider incorporating their practices into the formal program. In any case, involve the supervisors in the decisions about the policies.

Other questions worth looking at include: Is the data being collected relevant? Does it measure a critical element of the goal? Does the type of data display help one see gains? Is it easy for the supervisors to collect and display data? Is the system working with some populations or crews and not with others? If so, why? Are the rewards in the positive incentive program functioning as reinforcers for high attendance rates? Are rewards being conferred appropriately for the system to work effectively?

The system should be recycled on a regular basis. If anomalies start to show up in the daily recording and display then the system should be recycled to head off a possible

problem. About 3 months after any change to the system, recycle to see the effects of these efforts. If things are working, one should still recycle through the program on an annual basis. This will ensure gains are maintained and the system is working. For the most effective use of the program, ensure that it is applied consistently and allowed to undergo adaptive changes when it is recycled.

The following considerations are recommended as part of the recycling phase of the absence control program:

- Recycling means to evaluate the program and correct any problems.
- Recycling is important since it helps the program adapt to fit the needs of the particular site, and it helps maintain the gains.
- Recycle on a regular basis:
  1. If the daily recording of attendance data shows a potential problem.
  2. About 3 months after a change to the system.
  3. If things are working, recycle through the program on an annual basis. This will ensure that the system is consistently applied and keeps working properly.

## SUMMARY AND CONCLUSIONS

The major determinants of job attendance appear to vary significantly from one group of miners to another. Therefore, before adopting a plan for increasing attendance at a particular mine site, one should try to identify the major reasons for absenteeism at that mine. Three general areas for improving attendance are improving employment procedures; overcoming problems that make employees unable to attend work; and increasing employees' motivation to attend work.

With regard to employment procedures, research suggests that employers should attempt to review prospective mine employees' past attendance records before making a hiring decision. It may also be advisable to give prospective mine employees a realistic job preview before offering them employment, especially if they are to work underground.

When employees are unable to attend work, it is usually because they are experiencing one of the following: a physical or mental health problem, an injury, or a transportation problem. It has been estimated that from one-half to two-thirds of all absenteeism is due to illnesses. In order to reduce the amount of time lost because of miners illnesses, employers should consider providing miners with information about the importance of good health and how to achieve it. It may also be advisable to offer certain types of medical services (e.g., influenza vaccinations). Mental health problems can often be dealt with successfully by referring troubled employees to an EAP. To reduce the amount of time lost because of work-related injuries, one should attempt to find out what is causing them, and then take appropriate countermeasures to prevent them.

Employers who wish to increase mine employees' motivation to attend work should consider doing the following: give supervisors training on how they should respond to employee's absences; give miners periodic training on the company's policies concerning absenteeism and how good attendance is necessary for the mine to be operated in a safe and profitable manner; post attendance information; enrich (redesign) jobs to increase employee involvement; provide some remuneration for unused sick leave, and provide incentives (both rewards and negative sanctions) that are based on job attendance.

A program for improving miners' attendance was described that has the following four stages: (1) measure and

display data, (2) state goals and absenteeism policy, (3) develop and implement attendance promotion program, and (4) recycle.

The first stage, measure and display attendance data, was described as a prerequisite to any of the other stages. It is a continuous process during the entire program.

The next stage, stating the goals and the absenteeism policy, is considered important as it informs workers of what is expected and of impending changes. This information can positively impact attendance and can help the rest of the program to succeed. During this stage, goals are set with respect to attendance. The absenteeism policy statement should be precise and understandable. It should explain what absences are excusable, the procedures for reporting off, and the negative sanctions for violating the rules.

Developing and implementing an attendance promotion program is the stage where attendance improvement strategies are tried. Two strategies that appear to hold much promise for improving miners' attendance motivation are (1) supervisory interventions and (2) incentive programs.

An immediate supervisor can facilitate better attendance by: publicly charting attendance, treating absent workers reasonably, and referring employees who may have off-the-job problems.

A positive incentive program needs to have a criterion for success, which is within reach. In establishing this criterion, it helps to review attendance rates during prior time periods. Small rewards given frequently will have more effect than large rewards given after a long period of time. Rewards should be chosen that will reinforce attendance. Charts can be used to help bridge the gap in time between behaviors and the receipt of rewards.

The last stage in this program is to recycle. Recycling means to evaluate the effectiveness of the program and make needed changes. The system should be recycled on an annual basis unless changes are made to the system or some irregularities in the data suggest a problem is developing. Recycling will ensure that the system is working as planned, the program is tailored to the specific needs of the mine, and gains are maintained.

## REFERENCES

1. Adkins, J. Absenteeism: A Perspective on the Problem and Suggestions for Solutions. *Min. Congr. J.* Aug. 1980, pp. 19-23.
2. Allen, S. G. An Empirical Model of Work Attendance. *Rev. Econ. Stats.* v. 63, 1981, pp. 77-87.
3. Arvey, R., and J. Ivancevich. Punishment in Organizations: A Review, Propositions, and Research Suggestions. *Acad. Manage. Rev.*, 1980, v. 5, No. 4, pp. 123-132.
4. Baum, J. Effectiveness of an Attendance Control Policy in Reducing Chronic Absenteeism. *Personnel Psych.*, v. 31, 1978, pp. 71-81.
5. Braugh, J. A. Predicting Absenteeism From Prior Absenteeism and Work Attitudes. *J. Appl. Psychol.*, v. 66, 1981, pp. 555-560.
6. Bureau of National Affairs, Inc. (Washington, DC) Job Absence and Turnover Control. *Personnel Policies Forum Surv.* 132, Oct. 1981, 68 pp.
7. Campbell, N. Basic Guidelines for Establishing an EAP. Paper in Human Engineering and Human Resource Management in Mining. Proceedings: Bureau of Mines Technology Transfer Seminar, Pittsburgh, PA, July 7-8, 1987; St. Louis, MO, July 15-16, 1987; and San Francisco, CA, July 21-22, 1987; comp. by Staff, Bureau of Mines. BuMines IC 9145, 1987, pp. 117-122.
8. Dalton, D., and J. Perry. Absenteeism and the Collective Bargaining Agreement: An Empirical Test. *Acad. Manage. J.*, v. 24, No. 1, 1981, pp. 425-431.
9. Goodman, P. S. Assessing Organizational Change: The Rushton Quality of Work Experiment. Wiley, 1979, 391 pp.
10. \_\_\_\_\_. Analysis of Miners' Job Attendance Behavior and Its Relationship to Miners' Accidents and Injuries—Final Report (contract J0328033, Carnegie-Mellon Univ.). BuMines OFR 60-86, 1985, 278 pp.; NTIS PB 86-216306.
11. \_\_\_\_\_. Research to Determine the Feasibility of Utilizing Employee Assistance Programs for the Mining Industry—Final Report (contract J0100069, Carnegie-Mellon Univ.). BuMines OFR 73-86, 1986, 234 pp.; NTIS PB 86-277089.
12. \_\_\_\_\_. Examination of the Design of Bonus Plans in Underground Mining. Paper in Human Engineering and Human Resource Management in Mining. Proceedings: Bureau of Mines Technology Transfer Seminar, Pittsburgh, PA, July 7-8, 1987; St. Louis, MO, July 15-16, 1987; and San Francisco, CA, July 21-22, 1987; comp. by Staff, Bureau of Mines. BuMines IC 9145, 1987, pp. 106-116.
13. Goodman, P. S., and E. Lawler. New Forms of Work Organization in the United States. *Intl. Labor Org.* (Geneva, Switzerland) Monograph 1977, 17 pp.; available from R. H. Peters, Bureau of Mines, Pittsburgh, PA.
14. Harvey, B., J. Rogers, and J. Schultze. Sick Pay Versus Well Pay: An Analysis of the Impact of Rewarding Employees for Being on the Job. *Public Personnel Manage. J.*, v. 12, 1983, pp. 218-224.
15. Hedges, J. N. Absence From Work—A Look at Some National Data. *Mon. Labor Rev.*, v. 96, July 1973, pp. 24-30.
16. \_\_\_\_\_. Unscheduled Absence From Work—An Update. *Mon. Labor Rev.*, v. 98, Aug. 1975, pp. 36-39.
17. \_\_\_\_\_. Absence From Work—Measuring the Hours Lost. *Mon. Labor Rev.*, v. 100, Oct. 1977, pp. 16-23.
18. Hejda, S., J. Smola, and J. Masek. Influence of Physiological Vitamin C Allowances on the Health Status of Miners. *Rev. Czech. Med.*, v. 22, No. 2, 1976, pp. 90-97.
19. Kanugo, R. Work Alienation: An Integrative Approach. Praeger, 1982, 200 pp.
20. Katz, D., and R. Kahn. *The Social Psychology of Organizations*. Wiley, 2d ed., 1978, 838 pp.
21. Keller, R. T. Predicting Absenteeism From Prior Absenteeism, Attitudinal Factors, and Nonattitudinal Factors. *J. Appl. Psychol.*, v. 68, No. 3, 1983, pp. 536-540.
22. Kempen, R. Absenteeism and Tardiness. Ch. in *Handbook of Organizational Behavior Management*, ed. by L. Frederickson. Wiley, 1982, pp. 15-29.
23. Kempen, R., and R. Hall. Reduction of Industrial Absenteeism: Results of a Behavioral Approach. *J. Organizational Behavior Manage.*, v. 1, 1977, pp. 89-98.
24. Kopelman, R., G. Schneller, and J. Silver. Parkinson's Law and Absenteeism: A Program to Rein in Sick Leave Costs. *Personnel Administrator*, v. 26, No. 5, 1981, pp. 57-64.
25. Kuzmits, F. The Impact of a Legalistic Control Policy on Selected Measures of Absenteeism Behavior. Ch. in the *Eastern Academy of Management Proceedings of the Eighteenth Annual Meeting*, ed. by R. Kilmann and M. Jelinek. *Acad. Management* (Binghamton, NY), 1981, pp. 65-75.
26. Latham, G., and N. Napier. Practical Ways to Increase Employee Attendance. Ch. in *Absenteeism*, ed. by P. Goodman and R. Atkin. Jossy-Bass, 1984, pp. 322-359.
27. Lawler, E. Pay and Organizational Development. Addison-Wesley, 1981, 253 pp.
28. Leigh, J. Unionization and Absenteeism. *Appl. Economics*, v. 16, No. 1, 1984, pp. 147-157.
29. Leon, C. Employed But Not at Work: A Review of Unpaid Absences. *Mon. Labor Rev.*, v. 104, 1981, pp. 18-22.
30. Malott, R. W. Contingency Management, Or How To Get Things To Be The Way They Should. Ch. in *An Introduction to Behavior Modification*, ed. by R. W. Malott, K. Ritterby, and E. L. C. Wolf. Behaviordelia, Inc., 1977, pp. 6-1—6-17.
31. Miller, L. M. *Behavior Management: The New Science of Managing People at Work*. Wiley, 1978, 233 pp.
32. Miner, J. B., and J. F. Brewer. The Management of Ineffective Performance. Ch. in *Handbook of Industrial and Organizational Psychology*, ed. by M. D. Dunnette. Rand McNally, 1976, pp. 995-1029.
33. Morse, W. H. Intermittent Reinforcement. Ch. in *Operant Behavior Areas of Research and Application*, ed. by W. K. Honig. Prentice-Hall, 1966, pp. 52-108.
34. National Academy of Sciences (Nat'l. Res. Council). *Toward Safer Underground Coal Mines*. Nat'l. Acad. Press, 1982, 190 pp.
35. Neter, J., W. Wasserman, and M. H. Kutner. *Applied Linear Regression Models*. Irwin, 1983, 547 pp.
36. Nicholson, N. Management Sanctions and Absence Control. *Human Relations*, 1976, v. 29, No. 2, pp. 139-151.
37. Pedalino, E., and V. Gamboa. Behavior Modification and Absenteeism: Intervention in One Industrial Setting. *J. Appl. Psych.*, v. 59, 1974, pp. 694-698.
38. Peters, R. Activities and Objects Most Commonly Associated With Underground Coal Miners' Back Injuries. Paper in *Back Injuries*. Proceedings: Bureau of Mines Technology Transfer Symposia, Pittsburgh, PA, August 9, 1983, and Reno, NV, August 15, 1983, comp. by J. Peay. BuMines IC 8948, 1983, pp. 23-31.
39. Peters, R. H., and R. F. Randolph. Causes of Coal Miner Absenteeism. BuMines IC 9161, 1987, 45 pp.
40. Peters, R., and L. Schaffer. Field Tests of a Model Health and Safety Program for the Mining Industry. BuMines IC 9075, 1986, 36 pp.
41. Rosen, H., and J. Turner. Effectiveness of Two Orientation Approaches in Hard-Core Unemployed Turnover and Absenteeism. *J. Appl. Psych.*, v. 55, 1971, pp. 296-301.
42. Rosenthal, R. Arbitral Standards for Absentee Discharge. *Labor Law J.*, v. 23, No. 1, 1979, pp. 732-740.
43. Rothlesberger, F. and Dickson, W. *Management and the Worker*. Harvard Univ. Press, 1939, 348 pp.
44. Schefflen, K., E. Lawler, and J. Hackman. Long Term Impacts of Employee Participation in the Development of Pay Incentive Plans: A Field Experiment Revisited. *J. Appl. Psych.*, v. 55, 1971, pp. 182-186.
45. Seatter, W. More Effective Control of Absenteeism. *Personnel*, v. 38, 1961, pp. 16-29.
46. Steers, R., and S. Rhodes. Knowledge and Speculation About Absenteeism. Ch. in *Absenteeism*, ed. by P. Goodman and R. Atkin. Jossy-Bass, 1984, pp. 229-275.
47. \_\_\_\_\_. Major Influences on Employee Attendance: A Process Model. *J. Appl. Psych.*, v. 63, No. 4, 1978, pp. 391-407.
48. Sulzer-Azaroff, B. Behavioral Approaches to Occupational Health and Safety. Ch. in *Handbook of Organizational Behavior Management*, ed. by L. W. Frederickson. Wiley, 1982, pp. 505-538.

49. Taylor, D. Absent Workers and Lost Work Hours, May 1978. *Mon. Labor Rev.*, v. 102, Aug. 1979, pp. 49-52.

50. Theodore Barry and Associates. Industrial Engineering Study of Hazards Associated With Underground Coal Mine Production. Volume 1, Analysis of Underground Hazards and Fatal Accidents (contract S0110601). BuMines OFR 4(1)-72, 1971, 298 pp.; NTIS PB 207 226.

51. U.S. Bureau of Labor Statistics (Dep. Labor). Supplement to the Current Population Survey, May 1985. Unpublished study, 30 pp., 1986; available upon request from Bruce Kline, U.S. Bureau of Labor Statistics, Washington, DC.

52. \_\_\_\_\_. Supplement to the Current Population Survey, May 1980. Unpublished study, 27 pp., 1981; available upon request from Bruce Kline, U.S. Bureau of Labor Statistics, Washington, DC.

53. U.S. Mine Safety and Health Administration (Dep. Labor). Injury Experience in Coal Mining. Dep. Labor IR 1182, 1986, 382 pp.

54. Wanous, J. P. *Organizational Entry: Recruitment, Selection, and Socialization of Newcomers*. Addison-Wesley, 1980, 267 pp.

55. Weisberg, S. *Applied Linear Regression*. Wiley, 1985, 324 pp.

56. Wexley, K., and W. Nemeroff. Effectiveness of Positive Reinforcement and Goal Setting as Methods of Management Development. *J. Appl. Psych.*, v. 60, 1975, pp. 446-450.

57. Wilkinson, J. If There's a Cure for Absenteeism, it's Something that Money Can't Buy. *Coal Age*, Nov. 1976, pp. 79-82.

## APPENDIX.—LINEAR MODELING: STATISTICAL ATTENDANCE MANAGEMENT TOOL

This report has detailed several methods that can be used to improve attendance. Aside from theoretical assurances that these methods ought to work, a manager also needs to have tools for objectively assessing the effectiveness of a specific implementation in a specific mining situation. An obvious first approach might be to implement a new program (e.g., attendance bonuses) and compare the attendance rates before and after the change. If the rates after the change are higher, the implementation has been effective. Likewise, if rates are the same or worse, the program has been ineffective.

Unfortunately, this simple approach has several potential flaws. First, it doesn't account for other things that may affect attendance. Second, even if all of the things known to affect attendance could be accounted for, there are still random fluctuations over time. This becomes a problem in evaluating a small change in attendance rates. Was the change significant and likely to persist, or was it nothing more than an ordinary random fluctuation?

An effective and relatively simple way to address these problems is to use statistical modeling techniques drawn from management science. This approach has been shown to be an effective way to manage a mining crew's productivity (9),<sup>1</sup> and it can be readily adapted to managing attendance. The method is actually simpler than it sounds. It is merely a way to simultaneously assess the relative influences of all of the

factors likely to influence an important outcome (e.g., production, accidents, or attendance). For instance, figure A-1 shows a hypothetical mine's attendance patterns over about 6 months (128 days). As indicated on the graph, several significant events occurred during this period. Hunting season was open during part of the period, and there was also a heavy snowstorm that overlapped part of the hunting season. The management at this mine had instituted a new incentive program designed to improve attendance about 1 month into the period and would like to know how well it worked.

As the graph shows, attendance rates under the new plan were sometimes higher and sometimes lower than before. As you might expect, the lowest points were during hunting season and the snowstorm because, as this report has previously shown, off-the-job recreation and transportation problems are two frequent causes of absenteeism.

### SETTING UP DATA

Two types of data are used for this modeling approach: data on inputs and outputs. In this case, the output data is simply the number of miners working on a given day. The inputs are factors that are expected to affect overall attendance. The choice of data to include as inputs should be guided in part by the discussion at the beginning of this report concerning motivational and ability factors that have been shown to cause absences. Not only should the input data be

<sup>1</sup> Italic numbers in parentheses refer to items in the list of references preceding the appendix.

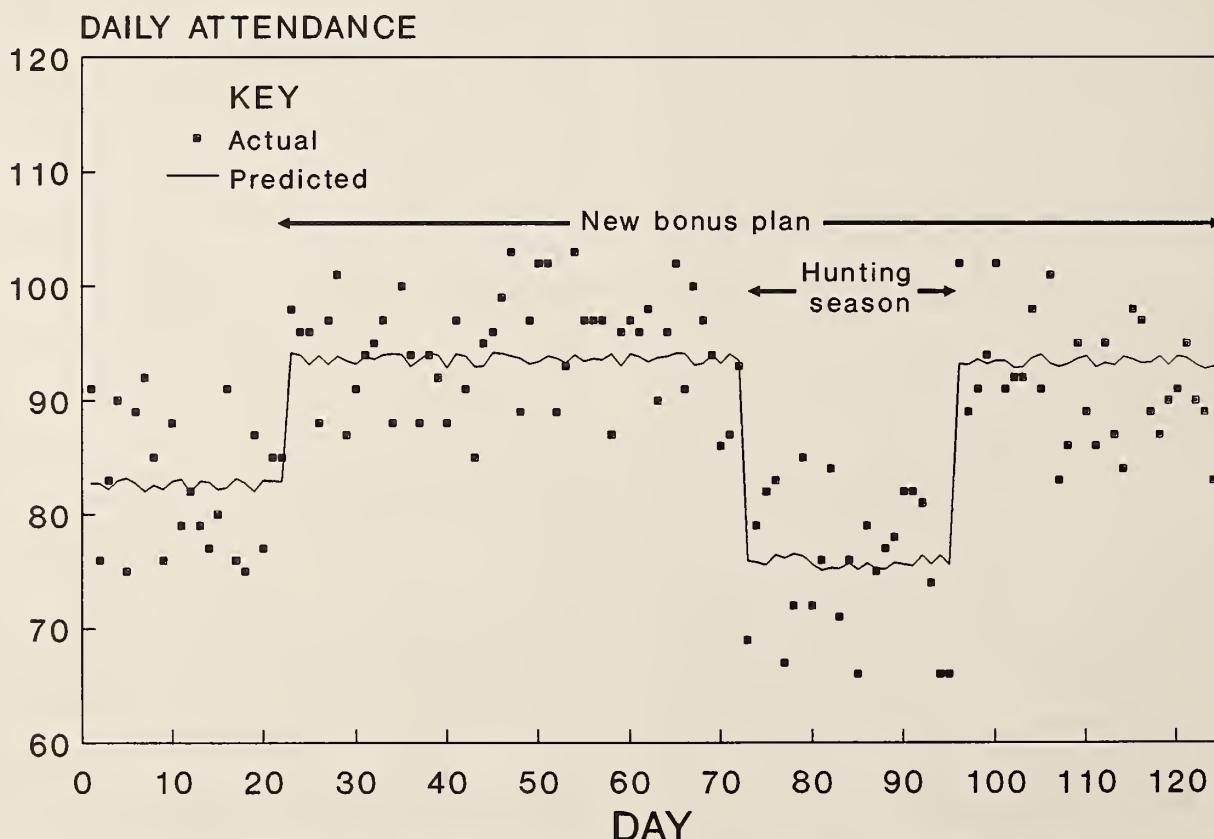


Figure A-1.—Daily mine attendance fluctuations for statistical attendance modeling example.

plausibly linked to absenteeism, it should also be readily available and easy to measure. Table A-1 shows the types of data that can be used and some suggested sources. For the best results, several variables should be selected from the list to measure miners motivation to attend as well as their perceived ability to attend.

**Table A-1.—Suggested sources of data for statistical attendance control**

Variable name	Examples of data sources
Attendance motivation:	
Overall satisfaction .....	Supervisors' daily report: Equipment downtime, working conditions. Periodic interviews. Grievances. Amount paid in incentives. Shift rotation schedule.
Desire to avoid income loss.....	Local unemployment rate. Mining industry employment.
Desire to perform off-the-job activities .....	Day of the week. Closeness to holiday. Hunting season.
Job involvement .....	Periodic interviews.
Distributive justice .....	Do.
Attendance norms .....	Do.
Personal work ethic .....	Do.
Perceived ability to attend:	
Transportation problems .....	Storms. Transportation strikes.
Health status .....	Miners' age. Availability-use of health programs.
Safety.....	Accident records. Supervisors' daily report: safety conditions, roof-rib-floor problems, gas.

For this example, only three variables were selected; implementation of an attendance bonus plan, hunting season, and delays owing to machine downtime. All three of these variables are aspects of a miner's motivation to attend work. The attendance bonus should increase the attractiveness of coming to work while excessive equipment downtime has been shown to be a common source of frustration that reduces the attractiveness of work. Hunting is a popular activity in many mine communities and reduces attendance by drawing miners away from work. Hence, our three variables represent a motivational pull towards attendance (bonus), a push away from attendance (delays), and a pull away from attendance (hunting). In real applications, several additional variables should be added, particularly from the list of ability factors (transportation problems, health, and safety).

## ESTIMATING MODEL

The statistical technique used to model the effects of the input variables on attendance is called multiple linear regression. Even a simple regression involves such a large number of calculations that it has only become a practical tool with the advent of modern computers. Fortunately, regression software is readily and inexpensively available for even the smallest popular personal computers. The analysis for this example was performed on a microcomputer using the popular Lotus 1-2-3<sup>2</sup> general purpose spreadsheet software, although dozens of other programs would have worked just as well.

In any regression program, the analyst must define the input variables (sometimes called independent variables) as well as the daily attendance (the dependent variable, in this case). The regression then determines a mathematical function of input variables that best fits their relationship to the dependent variable. Table A-2 shows how the information on inputs and attendance for a 125-day period at the hypothetical mine were tabulated in preparation for the analysis. The attendance numbers were entered into a column with parallel columns for the three input variables. The input variables for the bonus plan and hunting season take on values of either 1 or 0. This is a numbering system that should be used when dealing with conditions that either exist or do not exist. For instance, there either is a bonus plan (with this condition coded as 1) or there is not (coded as 0). Variables that can take on a range of values, such as minutes of machine delay, should be used directly. Likewise, the bonus variable could be coded as the amount of money offered (if it is a cash bonus system) so that several levels of bonuses could be compared.

## INTERPRETING RESULTS

Among the output from the regression program (fig. A-2) are two types of numbers that are of particular importance. First, the  $R^2$  (R-squared) is a number between 0 and 1 that indicates how strongly the input and output variables are related. An  $R^2$  of 1 indicates a perfect correlation and 0 reflects no detectable correlation. In actual practice, higher numbers for  $R^2$  are better, but it is unlikely that any model based on actual data will approach a value of 1. A good rule of thumb for an attendance model is to attain an  $R^2$  of 0.5 or greater. The model calculated in our example achieved a relatively high  $R^2$  of 0.64 indicating that the input variables accounted for 64 pct of the variation in attendance.

The second group of numbers to use from the regression output are the regression coefficients. There will be one of these numbers for each of the input variables and they indicate the independent effects of changes in the input variable on attendance. In the hypothetical example, the coefficients for the bonus plan, hunting season, and machine delays were approximately 11, -18, and -0.03 respectively. This indicates that the bonus plan actually resulted in an increase in attendance of 11 miners per day and that the hunting season and machine delays had the expected negative effects on attendance.

The beneficial impact of the bonus plan might have been obscured by the other fluctuations in attendance if a more simple analysis had been performed. The average attendance for the period after the new plan was instituted had increased by approximately seven miners per day. It is quite obvious that the effect was diminished by the well-known effects of hunting season and machine delays, but the use of the model shows more precisely how large these effects were. The coefficient for the bonus plan indicates that it actually seems to have resulted in improved attendance of 11 miners per day. The difference between attendance improvements of 7 or 11 miners may be significant enough to affect a judgement of the value of the bonus plan. This modeling approach can provide the manager with better, more accurate information about attendance—information that can lead to better attendance management decisions.

This appendix has only scratched the surface of possible applications of statistical modeling to attendance. For a more complete discussion of applied regression, a number of basic textbooks are available (e.g., 35 and 55).

<sup>2</sup> Reference to specific products does not imply endorsement by the Bureau of Mines.

Table A-2.—Data used in attendance modeling example

Day	Attendance	Bonus plan	Hunting season	Machine delay	Day	Attendance	Bonus plan	Hunting season	Machine delay
1	91	0	0	84	64	96	1	0	79
2	76	0	0	84	65	102	1	0	68
3	83	0	0	103	66	91	1	0	67
4	90	0	0	75	67	100	1	0	107
5	75	0	0	65	68	97	1	0	101
6	89	0	0	83	69	94	1	0	74
7	92	0	0	111	70	86	1	0	101
8	85	0	0	89	71	87	1	0	69
9	76	0	0	103	72	93	1	0	91
10	88	0	0	77	73	69	1	1	89
11	79	0	0	69	74	79	1	1	94
12	82	0	0	113	75	82	1	1	103
13	79	0	0	76	76	83	1	1	69
14	77	0	0	78	77	67	1	1	80
15	80	0	0	102	78	72	1	1	66
16	91	0	0	97	79	85	1	1	72
17	76	0	0	65	80	72	1	1	100
18	75	0	0	82	81	76	1	1	120
19	87	0	0	111	82	84	1	1	114
20	77	0	0	72	83	71	1	1	116
21	85	0	0	74	84	76	1	1	98
22	85	0	0	77	85	66	1	1	119
23	98	1	0	65	86	79	1	1	97
24	96	1	0	73	87	75	1	1	116
25	96	1	0	105	88	77	1	1	117
26	88	1	0	75	89	78	1	1	95
27	97	1	0	105	90	82	1	1	100
28	101	1	0	76	91	82	1	1	107
29	87	1	0	93	92	81	1	1	71
30	91	1	0	104	93	74	1	1	100
31	94	1	0	78	94	66	1	1	71
32	95	1	0	87	95	66	1	1	103
33	97	1	0	74	96	102	1	0	104
34	88	1	0	70	97	89	1	0	105
35	100	1	0	72	98	91	1	0	87
36	94	1	0	113	99	94	1	0	103
37	88	1	0	90	100	102	1	0	93
38	94	1	0	65	101	91	1	0	93
39	92	1	0	74	102	92	1	0	116
40	88	1	0	116	103	92	1	0	114
41	97	1	0	70	104	98	1	0	84
42	91	1	0	76	105	91	1	0	72
43	85	1	0	113	106	101	1	0	101
44	95	1	0	111	107	83	1	0	113
45	96	1	0	66	108	86	1	0	104
46	99	1	0	67	109	95	1	0	85
47	103	1	0	77	110	89	1	0	77
48	89	1	0	83	111	86	1	0	115
49	97	1	0	104	112	95	1	0	99
50	102	1	0	96	113	87	1	0	107
51	102	1	0	77	114	84	1	0	79
52	89	1	0	83	115	98	1	0	88
53	93	1	0	100	116	97	1	0	100
54	103	1	0	74	117	89	1	0	98
55	97	1	0	95	118	87	1	0	76
56	97	1	0	85	119	90	1	0	108
57	97	1	0	90	120	91	1	0	77
58	87	1	0	70	121	95	1	0	82
59	96	1	0	110	122	90	1	0	104
60	97	1	0	69	123	89	1	0	119
61	96	1	0	79	124	83	1	0	112
62	98	1	0	97	125	101	1	0	113
63	90	1	0	82					

Average before change:	82.64
Average after change:	89.57
Average difference:	6.94

Regression Output:	
Constant	84.87452
Std Err of Y Est	5.547504
R Squared	0.637926
No. of Observations	125
Degrees of Freedom	121
X Coefficient(s)	11.01826143 -17.6424 -0.02605
Std Err of Coef.	1.341325900 1.327857 0.031116

Figure A-2.—Computer output from regression analysis of example data.





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